INSTALLATION, OPERATION and MAINTENANCE MANUAL

ROTOGEAR® MAGNETIC-DRIVE PUMPS

3-SERIES: Models 31F, 33F, 35R, 35F, 37R, 37F, 39R, 39F & 311F - MC

H-SERIES: Models H3F, H5R, H5F, H7N, H7R & H7F - MC

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Forward

This manual provides instructions for the installation, operation and maintenance of the Rotogear® 3 & H Series gear pumps, Mag-Drive Models 31F, 33F, 35R, 35F, 37R, 37F, 39R, 39F, 311F, H3F, H5R, H5F, H7N, H7R & H7F. It is critical for any user to read and understand the information in this manual along with any documents this manual refers to prior to installation and start-up.

Liquiflo shall not be liable for damage or delays caused by a failure to follow the instructions for installation, operation and maintenance as outlined in this manual.

These pumps are not warranted for service other than those specified on the order by Liquiflo applications engineering. If it is desirable to use this product for alternative services, please call Liquiflo applications engineering or your local Liquiflo distributor.

Thank you for purchasing a Liquiflo product.

LIQUIFLO STANDARD TERMS AND CONDITIONS APPLY UNLESS SPECIFIED IN WRITING BY LIQUIFLO.

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Section 1: General Information

1.1 General Instructions

This manual covers the 3-Series and H-Series Mag-Drive Close-Coupled pumps, Models 31 thru 39, 311, and H3 thru H7.

The materials of construction of the pump are selected based upon the chemical compatibility of the fluid being pumped. The user must verify that the materials are suitable for the surrounding atmosphere.

If the fluid is non-conductive, methods are available to mechanically ground the isolated shaft. This is only necessary if the surrounding atmosphere is extremely explosive or stray static charges are present.

Upon receipt of your Liquiflo pump:

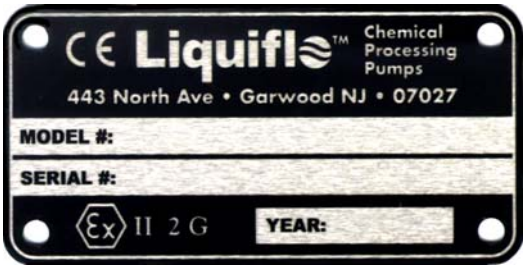
A) Verify that the equipment has not been damaged in transit.

B) Verify that the pump *Serial Number* is stamped on the pump's rear housing.

C) Verify that the *Liquiflo Stainless Steel Nameplate* is secured to the pump's housing:

D) For ATEX certification, verify that the following *Stainless Steel Tag* is attached to the pump:

Explanation of ATEX Tag	
Group II	Explosive atmospheres
Category 2	Equipment provides a high level of protection. Explosive atmospheres are likely to occur.
Category 3	Equipment provides a normal level of protection. Explosive atmospheres are unlikely to occur.
D	Dust
G	Gas



E) Record the following information for future reference:

Model Number:	
Serial Number:	
Date Received:	
Pump Location:	
Pump Service:	

NOTE: By adding a **K** prior to the pump's Model Code, a **Repair Kit** can be obtained which consists of the following parts: drive and idler gears, drive and idler shafts, wear plates, bearings, retaining rings, keys, housing alignment pins, bearing lock pins and O-rings. (See **Appendix 4** for more information.)

1.2 Pump Specifications

Table 1A: Performance Specifications (English System Units)

Pump Series	Pump Model	Max Flow	Max Speed	Max ΔP	Max Viscosity (2)	NPSHR (3)	Dry Lift (3)	TD (4)
	UNITS:	GPM	RPM	PSI	cP	ft	ft	GPR
3-Series	31F	0.48	1750	100	100,000	3	0.5	.000276
	33F	1.45	1750	100	100,000	2	1.5	.000828
	35R	2.41	1750	100	100,000	2	2	.001379
	35F	3.38	1750	100	100,000	2	4	.001930
	37R	8.59	1750	100	100,000	5.2	6	.004910
	37F	10.7	1750	100	100,000	5.2	7	.006140
	39R	15.1	1750	100	100,000	4	6	.008610
	39F	21.5	1750	100	100,000	3	14	.01228
	311F	21.5	1750	80	100,000	3	14	.01228
H-Series	H3F	1.45	1750	225 (1)	100,000	2	1.5	.000828
	H5R	2.41	1750	225 (1)	100,000	2	2	.001379
	H5F	3.38	1750	225 (1)	100,000	2	4	.001930
	H7N	5.37	1750	225 (1)	100,000	5.2	6	.003070
	H7R	8.59	1750	225 (1)	100,000	5.2	6	.004910
	H7F	10.7	1750	225 (1)	100,000	5.2	7	.006140

Table 1B: Performance Specifications (SI System Units)

Pump Series	Pump Model	Max Flow	Max Speed	Max ΔP	Max Viscosity (2)	NPSHR (3)	Dry Lift (3)	TD (4)
	UNITS:	LPM	RPM	bar	mPas	m	m	LPR
3-Series	31F	1.83	1750	6.9	100,000	0.9	0.15	.001045
	33F	5.48	1750	6.9	100,000	0.6	0.46	.003134
	35R	9.13	1750	6.9	100,000	0.6	0.6	.005220
	35F	12.8	1750	6.9	100,000	0.6	1.2	.007306
	37R	32.5	1750	6.9	100,000	1.6	1.8	.018586
	37F	40.7	1750	6.9	100,000	1.6	2.1	.023242
	39R	57.0	1750	6.9	100,000	1.2	1.8	.032592
	39F	81.3	1750	6.9	100,000	0.9	4.3	.04648
	311F	81.3	1750	5.5	100,000	0.9	4.3	.04648
H-Series	H3F	5.48	1750	15.5 (1)	100,000	0.6	0.46	.003134
	H5R	9.13	1750	15.5 (1)	100,000	0.6	0.6	.005220
	H5F	12.8	1750	15.5 (1)	100,000	0.6	1.2	.007306
	H7N	20.3	1750	15.5 (1)	100,000	1.6	1.8	.011621
	H7R	32.5	1750	15.5 (1)	100,000	1.6	1.8	.018586
	H7F	40.7	1750	15.5 (1)	100,000	1.6	2.1	.023242

NOTES:

1 Max ΔP (Differential Pressure) is derated to 125 PSI (8.6 bar) for viscosities < 10 cP (mPas).
2 Fluid viscosities > 150 cP (mPas) should use pumps with trimmed gears to reduce power consumption and increase pump efficiency. High-viscosity fluids may require larger pumps with trimmed gears operating at lower speeds. Consult factory.
3 NPSHR and Dry Lift are Specified @ Max Speed and 1 cP (mPas).
4 TD (Theoretical Displacement) is based on new pump operating @ Max Speed and ΔP = 0.

Table 2: Absolute Temperature & Pressure Ratings

Pump Series	Pump Models	Minimum Operating Temperature		Maximum Operating Temperature (1)		Maximum Operating Pressure (3)	
	UNITS:	°F	°C	°F	°C	PSIG	bar (g)
3-Series	31F, 33F, 35R & 35F	-40	-40	500	260	300	20.7
	37R, 37F, 39R, 39F & 311F	-40	-40	500	260	225	15.5
H-Series	H3F, H5R & H5F	-40	-40	500	260	300	20.7
	H7N, H7R & H7F	-40	-40	500	260	225	15.5

NOTES:

1 The actual maximum surface temperature depends not on the pump but primarily on the temperature of the fluid being pumped. Temperature class can be controlled with the use of thermal sensors. Pump surfaces will be approximately 20 °F (7 °C) above the temperature of the fluid being pumped.

2 Pump is designed to operate within the ambient temperature range of -4 °F (-20 °C) and 104 °F (40 °C).

3 For pumps with ANSI 150# RF Flanges, the Maximum Operating Pressure Rating of the flange is 285 PSIG within the temperature range of -20 to 100 °F. Above 100 °F, derate by 0.29 PSIG/°F.

Table 3: Maximum Torque Specifications (in-lbs)

Parameter	3-Series	31F	33F	35R	35F		37R	37F	39R	39F	311F
	H-Series		H3F	H5R	H5F	H7N	H7R	H7F			
Idler Gear Teflon		—	4	7	10	14	22	27	38	54	54
Idler Gear Carbon		3	9	15	21	28	45	56	79	113	113
Idler Gear Celcon/Delrin		4	11	19	26	36	57	71	99	142	142
Idler Gear PEEK		4	12	20	28	38	61	76	107	153	153
Idler Gear Ryton		4	12	20	28	38	61	76	107	153	153
Double Metal Gears		23	23	74	74	134	189	189	189	189	189
Magnetic Coupling Size	MCS	33				—	—	—	—	—	—
	MCU	75								—	—
	MCA	66								—	—
	MCB	120									
	MCC	—	—	240							
	MCV	—	—	200							

Table 4: Weight Data

Parameter	3-Series	31F	33F	35R	35F		37R	37F	39R	39F	311F	Unit
	H-Series		H3F	H5R	H5F	H7N	H7R	H7F				
Pump Weight *		31	31	32	32	36	36	36	38	40	40	lbs
		14	14	15	15	16	16	16	17	18	18	kg

* Weight of pump with threaded ports, excluding motor.

Table 5: Material Data

Component	Material(s)
Pump Housing	316 Stainless Steel, Alloy-20 or Alloy-C
Mounting Hardware	18-8 Stainless Steel
Mounting Bracket (Pedestal)	Epoxy Painted Cast Iron
Motor Frames (C-Face)	NEMA 56C/56HC, 143/145TC & 182/184TC; IEC 71/80/90 (B5 Flange)
Bearings	Carbon, Carbon-60, Teflon, PEEK or Silicon Carbide (**Note 1**)
Wear Plates	Carbon, Carbon-60, Teflon, PEEK or Ceramic (**Note 1**)
Gears	316 SS, Alloy-C, PEEK, Ryton, Celcon, Delrin, Teflon or Carbon (**Note 1**)
Shafts	316 Stainless Steel or Alloy-C (**Note 2**)
Coating on Shafts	None, Ceramic Chrome Oxide or Tungsten Carbide
Housing Pins	316 Stainless Steel or Alloy-C (**Note 2**)
Bearing Pins	Teflon, 316 Stainless Steel or Alloy-C (**Note 2**)
Retaining Rings	316 Stainless Steel or Alloy-C (**Note 2**)
Keys	316 Stainless Steel or Alloy-C (**Note 2**)
O-rings	Teflon, Viton, EPDM, Buna-N, Kalrez or 316 SS/PFA Encapsulated
Magnetic Coupling	MCS and MCA Magnets: Ceramic MCU, MCB, MCC and MCV Magnets: Samarium Cobalt (SmCo) Inner Magnet Casing: 316 Stainless Steel or Alloy-C (**Note 2**) Outer Magnet Casing: Carbon Steel/Epoxy

NOTES:

1 Teflon is 25% glass-filled PTFE.
2 Metallic material will match pump housing material. (Exception: **Note 3**)
3 Alloy-20 pumps will have all metallic internal parts made from Alloy-C.

1.3 Model Coding

A fifteen-position **Model Code** is used to completely describe a specific mag-drive pump. This code is required when ordering a new pump or a cartridge, repair kit or replacement parts for an existing pump. The table below describes the Model Code and gives a specific example:

Table 6: Mag-Drive Pump Model Code Description & Example

Position #	Description	Pump Model Code Example: 35FS6P22000000US	
		Code	Selection
1	Pump Model (Size)	35	Model 35F (35 = Pump Size; F = Full Capacity)
2	Pump Model (Capacity)	F	
3	Basic Material & Port Type	S	316 SS Housing and Shafts & NPT Ports
4	Drive Gear	6	316 SS Drive Gear
5	Idler Gear	P	PEEK Idler Gear
6	Wear Plates	2	Carbon Wear Plates
7	Bearings	2	Carbon Bearings
8	Outer Magnet Bore (Motor Frame)	0	5/8" (NEMA 56C or 56HC Motor Frame)
9	Bearing Flush	0	No Bearing Flush
10	Shaft Coating	0	No Shaft Coating (Bare 316 SS Shafts)
11	O-rings	0	Teflon O-rings
12	Retaining Rings	0	316 SS Retaining Rings
13	Bearing Pins	0	Teflon Bearing Pins
14	Magnetic Coupling	U	MCU (75 in-lbs) Magnetic Coupling
15	Options	S	Single-Wall Containment Can

NOTE: See the Liquiflo Product Catalog or the Liquiflo Website (www.liquiflo.com) for complete Model Coding information.

1.4 Pump Installation

During installation of the pump and supporting equipment, follow the guidelines given in **Section 3**. Pay special attention to all cautionary notes in this section.

1.5 Start-Up

Before operating the pump, inspect the system as outlined in **Section 4**. Do not start the pump until the inspection is satisfactory and all safety precautions have been taken.

1.6 Operation & Troubleshooting

The successful and safe operation of a pump is not only dependent on the pump but also on each of the system components. It is therefore important to monitor the entire pumping system during operation and to perform the necessary maintenance to keep the system running smoothly.

A normally operating magnetic-drive gear pump will deliver a steady, pulse-less flow with no leakage, be relatively quiet and have a predictable flow rate based on the pump speed, fluid viscosity and differential pressure across the pump. Refer to the performance curves of the specific pump model being operated (see Liquiflo Product Catalog or website: www.liquiflo.com).

If a significant problem is observed during operation, the pump should be stopped so that corrective action can be taken. The observed problem could have several possible causes, and multiple remedies for each cause. For help with problem solving, refer to the Troubleshooting Guide given in **Appendix 7**.

1.7 Maintenance & Repair

The pump has internal bearings, wear plates, gears and shafts which require replacement over time due to physical wear. The center housing of the pump may also incur physical wear and require replacement (see **Appendix 3**). O-rings and retaining rings should always be replaced when rebuilding the pump.

Standard repair kits are available to facilitate repair of the pump (see **Appendix 4**). A repair kit includes all internal wear parts as well as O-rings, retaining rings, bearing lock pins, housing alignment pins and keys. The parts not included in a mag-drive pump repair kit are the housings (front, center and rear), magnets (inner and outer), containment can, pedestal and hardware (bolts, nuts and washers).

Before performing maintenance on the pump, review the safety precautions given in **Section 2**. Removal of the pump from the piping system is covered in **Section 5.2**. To disassemble the pump, follow the procedure in **Section 5.3**. To replace parts and reassemble the pump, follow the assembly procedure in **Section 5.4**. When performing maintenance, pay special attention to all cautionary notes given in these sections.

1.8 Repair Kits & Replacement Parts

Repair kits and replacement parts for the pumps can be purchased from your local Liquiflo distributor. Refer to **Appendices 4** thru **6** for individual parts information.

1.9 Returned Goods Authorization (RGA)

If it is necessary to return the pump to the factory for service,

1) Contact your local Liquiflo distributor to discuss the return, obtain a Returned Goods Authorization Number (**RGA #**) and provide the distributor with the required information (see RGA Record below).
2) Clean and neutralize pump.
3) Package the pump carefully and include the **RGA #** in a visible location on the outside surface of the box.
4) Ship pump to factory, freight prepaid.

Returned Goods Authorization (RGA) Record		
1	**RGA #**	**(Supplied by Distributor)**
2	**Distributor Name**	
3	**Order Date**	
4	**Customer PO#**	
5	**Return Date**	
6	**Item(s) Returned**	
7	**Serial Number(s)**	
8	**Reason for Return**	
9	**Fluid(s) Pumped**	
10	**Notes**	

NOTE: Pump must be cleaned and neutralized prior to shipment to the factory.

Section 2: Safety Precautions

2.1 General Precautions

- **Always** lock out the power to the pump driver when performing maintenance on the pump
- **Always** lock out the suction and discharge valves when performing maintenance on the pump
- **Never** operate the pump without safety devices installed
- **Never** operate the pump with suction and/or discharge valves closed
- **Never** operate the pump out of its design specifications
- **Never** start the pump without making sure that the pump is primed
- **Never** use heat to disassemble pump
- Inspect the entire system before start-up
- Monitor the system during operation and perform maintenance periodically or as required by the application
- Decontaminate pump using procedures in accordance with federal, state, local and company environmental regulations
- Before performing maintenance on the pump, check with appropriate personnel to determine if skin, eye or lung protection is required and how best to flush the pump
- Pay special attention to all cautionary statements given in this manual. **Failure to observe safety precautions can result in personal injury, equipment damage or malfunction.** Cautionary statements will have the following format:

CAUTION! (Statement)

2.2 Precautions for Magnetic-Drive Pumps

Magnetic-drive pumps contain strong magnets, which pose health risks. Based on this the following must be observed:

- Individuals with cardiac pacemakers should avoid repairs on these units
- Individuals with internal wound clips, metallic wiring, or other metallic prosthetic devices should avoid repairs on these units
- Strong magnetic fields can cause tools and parts to slam together, injuring hands and fingers

Strong magnets will attract iron, cast iron, carbon steel and some types of stainless steel. Keep magnets away from credit cards, computers, computer discs and watches.

Section 3: Pump & Motor Installation

3.1 Installation of Pump, Motor and Base

Refer to the Hydraulic Institute Standards for proper installation procedures of the base, pump and motor. Observe the following guidelines:

1) The foundation area must be rigid and level for maintaining pump alignment.

2) The pump and motor assembly must be securely fastened to the base, and the base must be securely attached to the ground.

3) The pump inlet should be as close to the liquid source as practical and preferably below it.

4) The pump and motor should be accessible for servicing and inspection.

5) The pump and motor should be cleaned periodically to prevent the build-up of dust.

NOTE: The pump models covered in this manual are close-coupled and no alignment procedure between the pump and motor is required.

3.2 General Piping Requirements

Guidelines for piping are given in the Hydraulic Institute Standards and should be reviewed prior to pump installation.

1) All piping must be supported independently and must line up naturally with pump ports.

CAUTION! Do not use the pump to support the piping or allow the piping to apply stress to the pump ports. This can distort the alignment of the pump housing with internal parts and lead to rapid wear or malfunction.

2) DO NOT make final connection of piping to pump until the grout has hardened and the pump and motor hold-down bolts have been tightened.

3) Piping that handles both hot and cold liquids require proper installation of expansion loops and joints so that thermal expansion of the piping will not cause misalignment.

4) Gasket installation and materials must be suitable for the service.

5) Piping runs should be designed to minimize friction losses.

6) Suction and discharge piping should be the same size or larger than the inlet and outlet ports.

7) The piping should be arranged to allow the pump to be flushed and drained prior to the removal of the pump for servicing. Valves and unions should be installed to allow the pump to be isolated during maintenance.

8) The piping system should be thoroughly cleaned prior to installation of the pump.

3.3 Gear Pump Requirements

1) A positive displacement pump should have a **pressure relief valve** installed in the discharge line. The relief valve should be the closest valve to the discharge port of the pump and should bypass the discharge line back to the supply tank.

2) The maximum particle size capable of being passed by the pumps is 37 microns. When pumping fluids containing solids, a **filter** of at least 400 U.S. Mesh should be installed in the suction line.

3) Concentration of solids should be limited to a maximum of 1%. Exceeding 1% can cause the wear rate to increase to an unacceptable level, resulting in a rapid decrease in pump performance. In addition to solids concentration, the specific wear rate also depends on the size, shape and hardness of the particles, the operating speed and the materials used to construct the pump.

3.4 General Motor Requirements

1) The motor must be compatible with the pump and conditions of the application.

2) The motor supply voltage must match the nameplate voltage of the motor.

3) The motor should never be operated outside of its design specifications.

4) The motor should be inspected periodically and serviced or replaced as required.

CAUTION! Lock out power to the motor before servicing or replacing.

3.4.1 Motor Selection

1) The motor frame must be compatible with the pump mounting bracket. Choices are NEMA 56C, 56HC, 143TC, 145TC, 182TC & 184TC, and IEC 71, 80 & 90 (B5 flange). NEMA 182/184TC motor frames will require an *adapter plate* (P/N SP0046) and four *adapter mounting bolts* (P/N 641105) to mount the motor to the bracket (see Page 29). (Note: Complete pumps ordered for use with NEMA 182/184TC motor frames will be supplied with the adapter plate and adapter mounting bolts.)

2) The motor must have an enclosure that is compatible with the application conditions. If an explosion-proof motor is required, the *temperature code* of the motor must be acceptable for the fluid that will be pumped.

3) The speed and power output rating of the motor must be sufficient for the conditions of service. The power output rating of the motor should exceed the maximum power that will be required by the pump over its operating range.

3.4.2 Motor Hook-Up

1) Electrical wiring of the motor should be performed by a certified electrician.

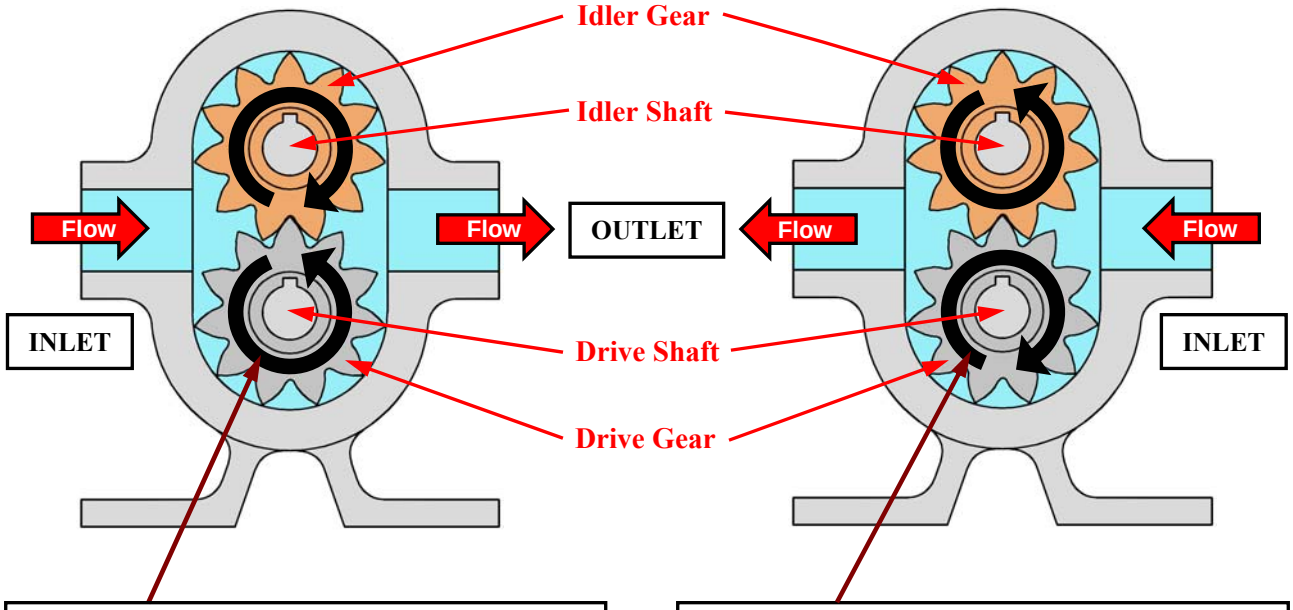
2) Follow the recommendations of the motor manufacturer and observe all electrical wiring safety standards.

3) The motor supply voltage must match the motor nameplate voltage or serious motor damage or fire can result.

CAUTION! Lock out power to the motor before connecting to power line.

3.4.3 Motor Direction

The motor shaft is magnetically coupled to the drive shaft of the pump. Both shafts will turn in the same direction. Because the gear pump is bi-directional, the pump shaft can turn in either direction to produce flow in either direction. The direction of rotation of the motor shaft (same as that of the pump drive shaft) will determine which side of the pump is the *inlet* (suction side) and which side is the *outlet* (discharge side). For the pump models covered in this manual, the flow direction will be as shown below:



Counterclockwise Rotation of Motor Shaft:

Fluid will enter the pump at the left side (inlet) and be discharged at the **right** side (outlet).

Clockwise Rotation of Motor Shaft:

Fluid will enter the pump at the right side (inlet) and be discharged at the **left** side (outlet).

Section 4: Start-Up & Operation

4.1 Precautions Prior to Starting Pump

1) Verify that the pump and motor are suitable for the conditions of service.

2) Verify that all suction and discharge valves are open before starting the pump.

3) Prime the pump and jog the motor to check the rotation. As viewed from the pump end, a clockwise rotation of the motor will result in fluid discharge to the left; counterclockwise rotation will result in fluid discharge to the right (see Page 12).

4) The pump is capable of pulling a dry lift, but it is still recommended that the pump be primed prior to starting.

5) A **pressure relief valve** should be installed in the discharge line to protect the pump from any kind of line blockage including the inadvertent closing of an isolation valve.

6) If the fluid contains suspended solids, a **filter** of at least 400 U.S. Mesh should be installed in the suction line. Concentration of solids should be limited to a maximum of 1%.

7) Ensure that all safety devices are installed before operating pump.

4.2 Operating Requirements

1) Do not operate the pump without fluid inside it.

CAUTION! Do not run pump dry for more than 30 seconds or damage to internal parts can result.

2) The pump should be operated with at least 20 PSI (1.4 bar) differential pressure to ensure that internal components are properly lubricated by the pumped fluid.

3) Adequate suction pressure must be available for the pump to function properly (see NPSHR data on Page 4).

4) Do not operate the pump outside of its design specifications (See Pages 4 and 5).

4.3 Troubleshooting

During pump operation, inspect for:

(1) Unusual noise
(2) Product leakage
(3) Expected suction and discharge pressures
(4) Product flow

If any problems are encountered with the above items, stop the pump and take corrective action. For help with troubleshooting, refer to **Appendix 7**.

Section 5: Maintenance & Repair

The pump has internal bearings, wear plates, gears and shafts which require replacement over time due to physical wear. The center housing of the pump may also incur physical wear and require replacement (see **Appendix 3**). O-rings and retaining rings should always be replaced when rebuilding the pump.

5.1 Work Safety

Before performing maintenance, review the safety precautions given in **Section 2** (see Page 9).

CAUTION! The Magnetic Couplings used in these pumps are extremely powerful. Observe the precautions given in Section 2.2.

5.2 Removal from System

Before servicing, prepare the pump as follows:

CAUTION! If the pump was used to move hazardous or toxic fluids, it must be flushed and decontaminated prior to removal from the system piping. Refer to the Material Safety Data Sheet (MSDS) for the liquid and follow all prescribed safety precautions and disposal procedures.

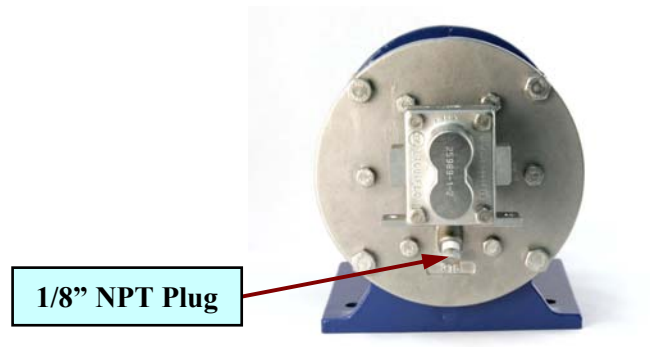
1. Flush the pump.
2. Stop the motor and lock out the electrical panel.

CAUTION! Be certain the pump's motor switch is in the OFF position and the power to the motor is locked out.

3. Close the suction and discharge isolation valves.
4. Disconnect the pump from the system piping.
5. Drain the containment can by removing the 1/8" NPT plug on the pump's front housing (see photo below).

Location & Removal of Drain Plug

To drain the containment can, remove the **1/8" NPT plug** that is located near the bottom of the pump's front housing (see photo).

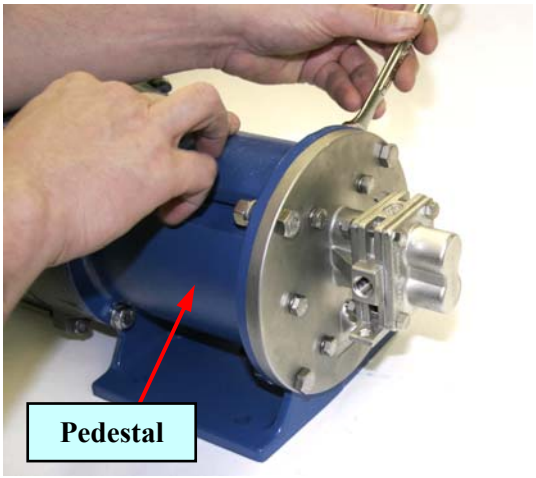


5.3 PUMP DISASSEMBLY

Follow the procedure below and refer to the drawings in **Appendix 6**.

Cartridge Removal:

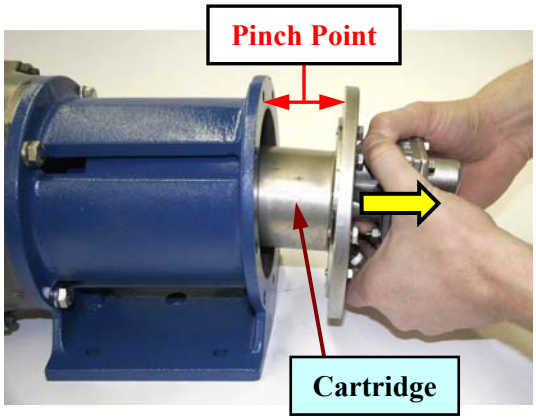
1 Remove the four front housing bolts (27) from the pedestal (16).



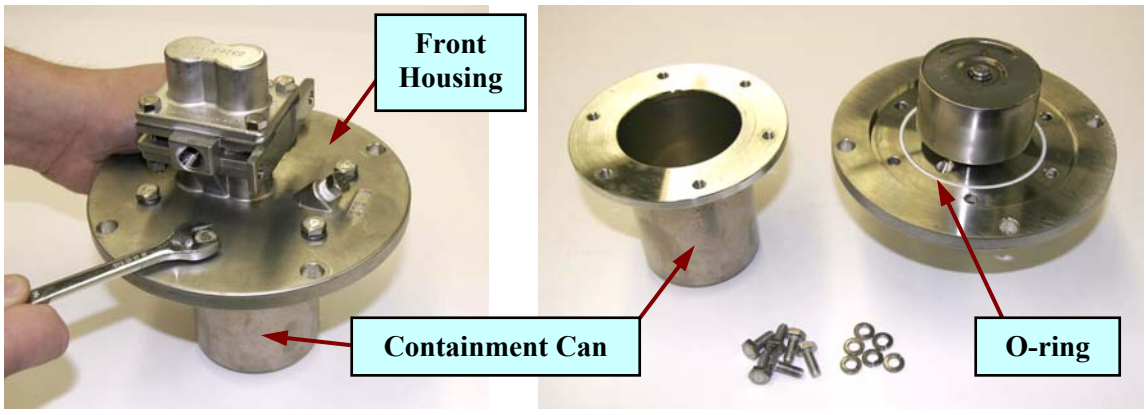
2 Carefully pull the **Cartridge** straight out.

CAUTION! Do not place hands or fingers between Pedestal and Pump Cartridge.

NOTE: Force must be applied to overcome the magnetic attraction between the outer and inner magnets. (See Page 20 for information on the **Pump Cartridge**.)



3 Remove six screws (18) and separate the containment can (12) from the front housing (8). Discard the containment can O-ring (19).



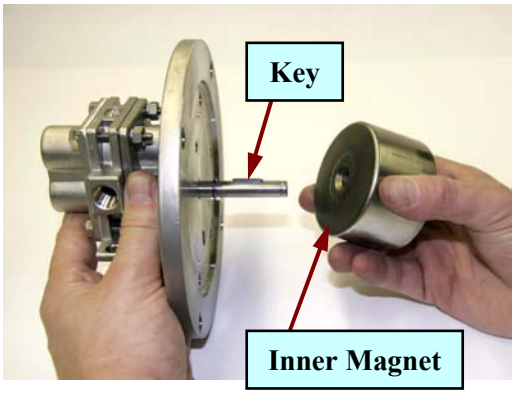
4 Detach the inner magnet (11) from the drive shaft (20) by removing the outer retaining ring (28). Remove the retaining ring by inserting a pointed tool in the split and prying off.

CAUTION! Be careful not to damage the shaft.

NOTE: After removal of the retaining ring, any high spots on the end of the shaft must be polished smooth so that free removal of the inner magnet is not inhibited.

---

5 Remove the inner magnet and key (13) from the drive shaft.



---

6 Dislodge the retaining ring (28) from the inner groove on the drive shaft.

CAUTION! Be careful not to damage the shaft.

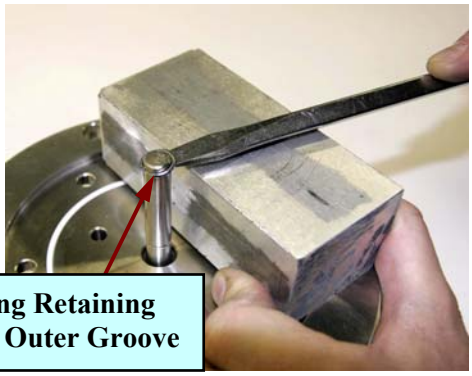
NOTE: The retaining ring can be dislodged from the inner groove by using a large flat screwdriver and a rigid bar, as shown.

---

7 Slide the retaining ring up the shaft and into outer groove. Then pry the retaining ring out of the groove and remove.

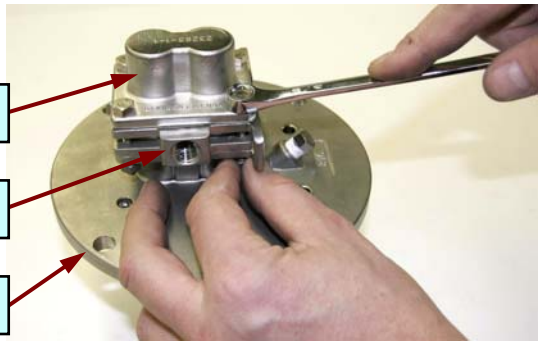
CAUTION! Be careful not to damage the shaft.

NOTE: The retaining ring can be dislodged from the outer groove by using a large flat screwdriver and a rigid block, as shown.



---

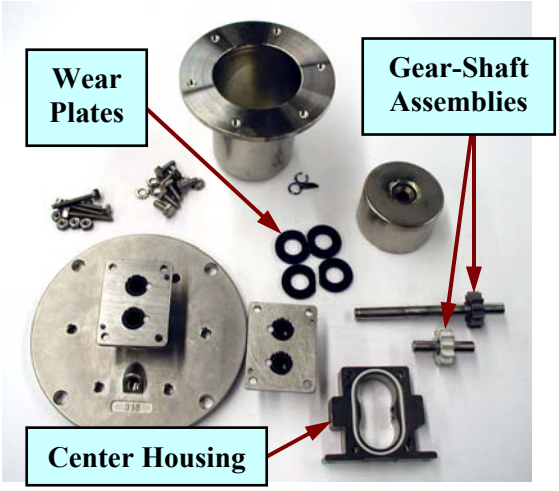
8 Remove the four housing bolts (4) and then separate the rear, center and front housings.



---

9 Remove the wear plates (7) and the gear-shaft assemblies. Remove the O-rings (5) from the center housing (21) and discard.

NOTE: Liquiflo Repair Kits come with the gears and shafts preassembled, as shown in **Appendix 4**. If you are using a repair kit to rebuild the pump, it is not necessary to separate the gears from the shafts. If this is the case, skip **Step 10** and proceed directly to **Step 11**.



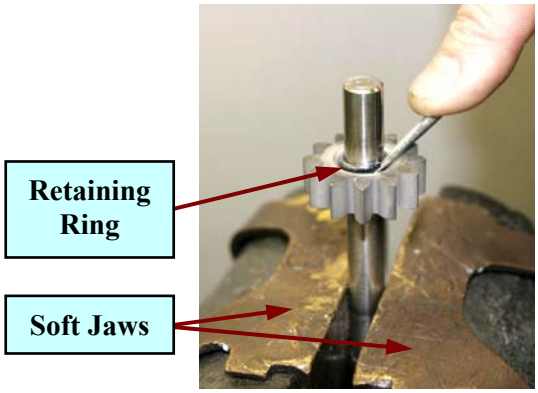
Gear-Shaft Disassembly:

10

CAUTION! Be careful not to damage the drive and idler shafts.

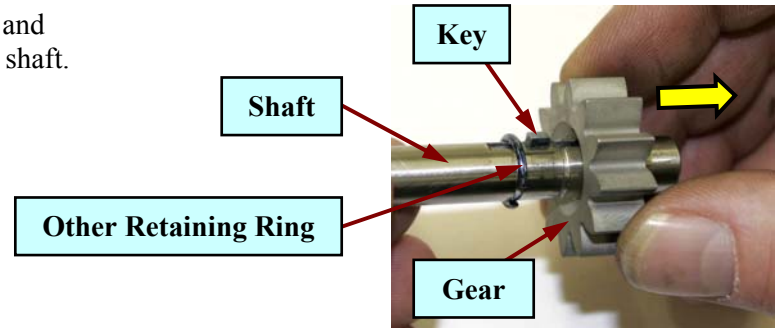
a. Remove one retaining ring (28) from the shaft (1 or 20).

NOTE: Use special vice jaws made of aluminum, bronze, brass or other soft material so as not to dent or damage the shaft (see photo at right).



---

b. Separate the gear (6 or 22) and key (23B or 23A) from the shaft.



---

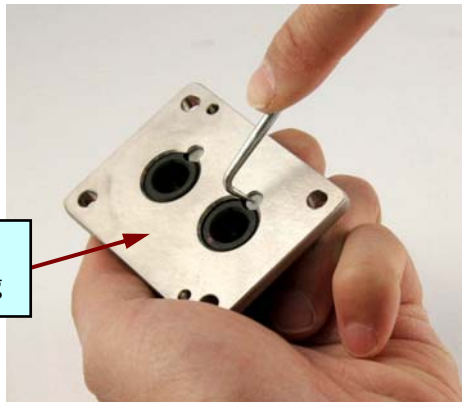
c. Remove the other retaining ring (28) from the shaft.

NOTE: One method for removing the retaining ring is shown at right. First bridge the shaft with a close fitting open-end wrench and then strike the wrench handle with a mallet to dislodge the retaining ring from the groove (see photo).

Removal of Bearing Lock Pins:

11 Remove the bearing lock pins (25) from the front and rear housings.

NOTE: If the pins are made of Teflon, a pointed tool can be used to extract them, as shown. If the pins are metallic, the bearings should be removed first (see **Step 12**).

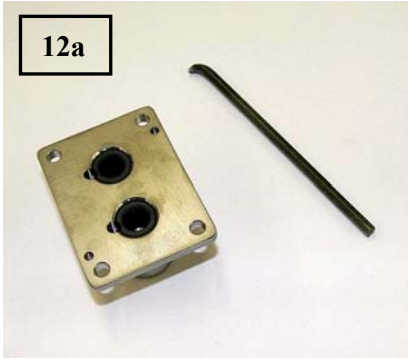


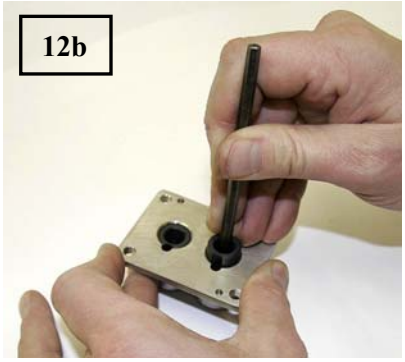
Removal of Bearings:

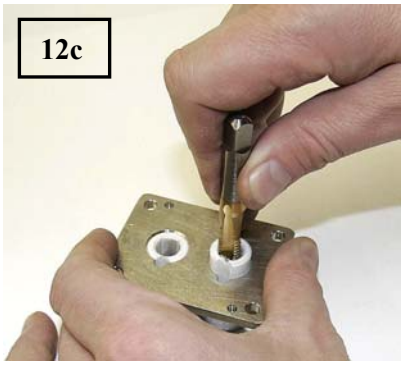
Most bearings for these pumps were designed to have a light press fit into the front and rear housings. Removal is generally accomplished by destroying the bearings. The bearings can be pulled out using a hooked tool (see Photos **12a** and **12b**). Plastic bearings, such as Teflon, can also be extracted by using a tap that is slightly larger than the bearing inner diameter (see Photo **12c**).

12 Remove the bearings (3A and 3B) from the front and rear housings.

CAUTION! Be careful not to damage the housing bores when removing the bearings.







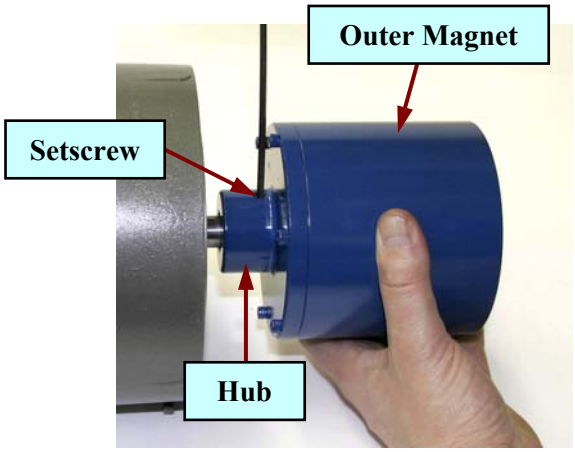
Removal of Outer Magnet:

13 **a.** Detach the motor (with outer magnet) from the pedestal (16) by removing four bolts (15).

NOTE: The pedestal is shown connected directly to a motor, but the pedestal could also be connected directly to the Liquiflo *S-Adapter* (P/N SADAPT) or the Liquiflo *Power Frame* (P/N A-620804). Each of these devices can be used to long-couple the mag-drive pump to the motor. If either of these devices are being used, the outer magnet will be installed not on the motor shaft, but on the shaft of the device. (See the Liquiflo Product Catalog or the Liquiflo Website for more information on the S-Adapter or Power Frame.)

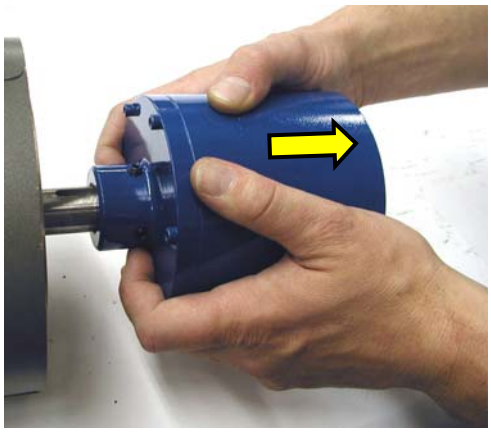
---

b. Loosen the two setscrews (17) on the hub (33) of the outer magnet (10).



---

c. Remove the outer magnet from the motor shaft.



END OF DISASSEMBLY PROCEDURE

5.4 PUMP ASSEMBLY

Follow the procedure below and refer to the drawings in **Appendix 6**.

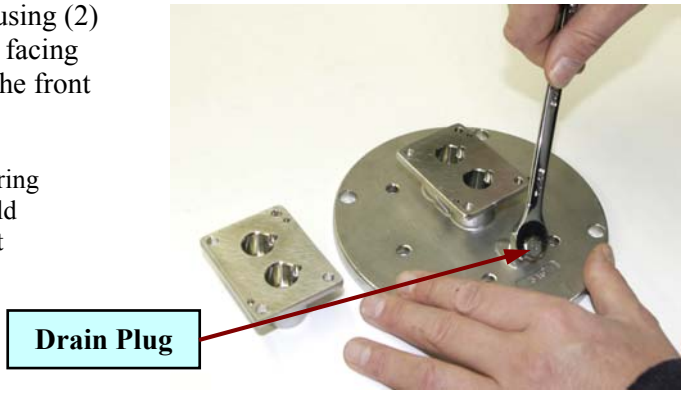
Part A: Pump Cartridge Assembly

A **Pump Cartridge** is a complete mag-drive pump less the outer magnet and pedestal (see photo at right). A cartridge replacement is a convenient way to quickly replace a pump that requires maintenance. Pump cartridges are available from the factory and are designated by placing a **C** in front of the pump model code.

Example:
Pump Model Code: 35FS6P22100000US
Cartridge Model Code: C35FS6P22100000US

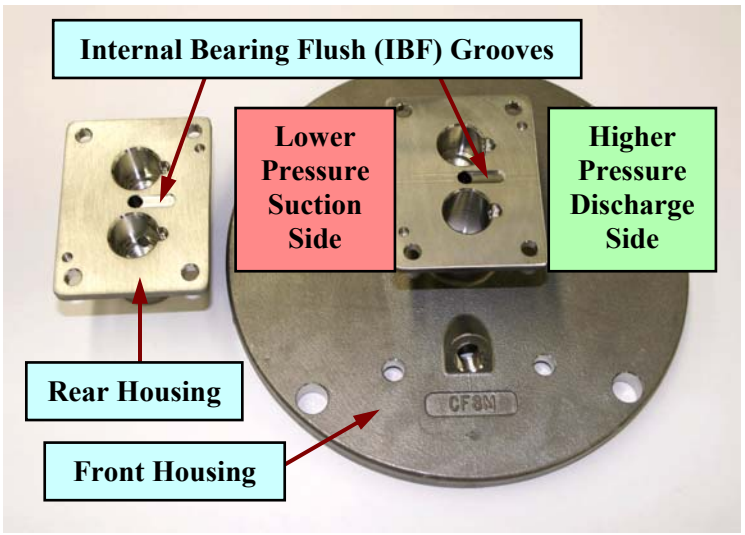
1 Place the front housing (8) and rear housing (2) on a flat surface with the bearing bores facing up. Install the 1/8" NPT plug (9) into the front housing.

NOTE: Standard housings (i.e., not containing bearing flush grooves) are shown at right. Teflon tape should be applied to the threads of the drain plug to prevent leakage.



Internal Bearing Flush Option

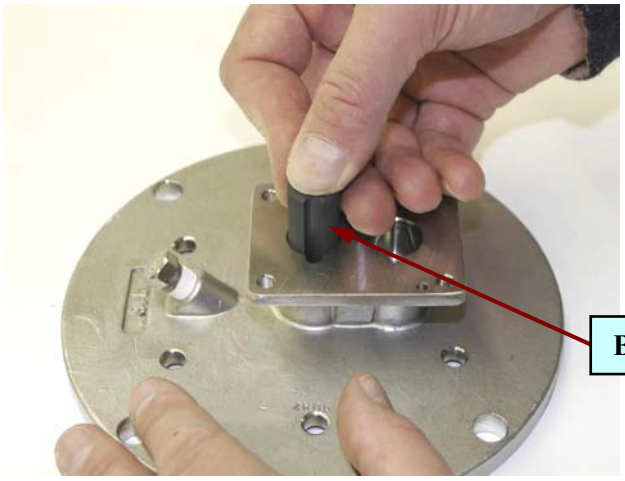
Pumps ordered with the Internal Bearing Flush (IBF) option will have **modified front and rear housings**, as shown at right. The purpose of the IBF option is to more effectively lubricate and cool the bearings when pumping extremely thin or extremely thick liquids. When assembling the pump, the IBF grooves must be oriented on the higher pressure discharge side of the pump.

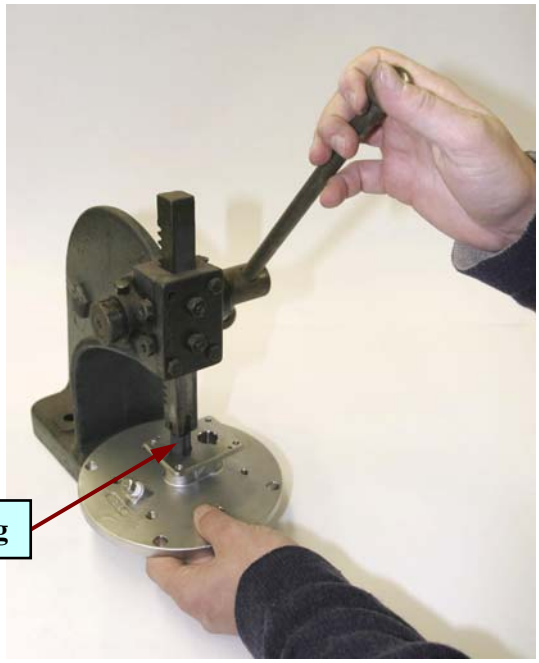


Installation of Bearings into Front and Rear Housings:

2 Insert bearings (3A & 3B) into the housing bores, while aligning the grooves for the bearing lock pins.

NOTE: If the bearings have not yet been removed from the front and rear housings, refer to **Step 12** of the disassembly procedure (see Page 18). The bearings normally require a light press fit to insert them into the housings. A mechanical press can be used to facilitate this process (see photos).

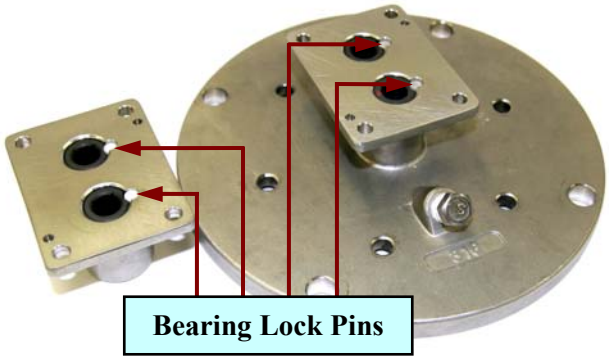




---

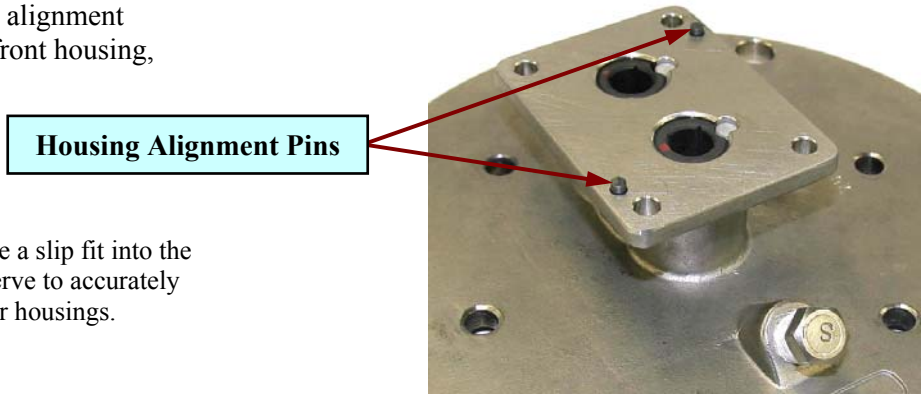
3 Insert the bearing lock pins (25) into the front and rear housings.

NOTE: The pins serve to prevent the bearings from rotating. They are normally made of Teflon. Metallic pins are available for high temperature applications.



---

4 Insert two housing alignment pins (24) into the front housing, as shown.

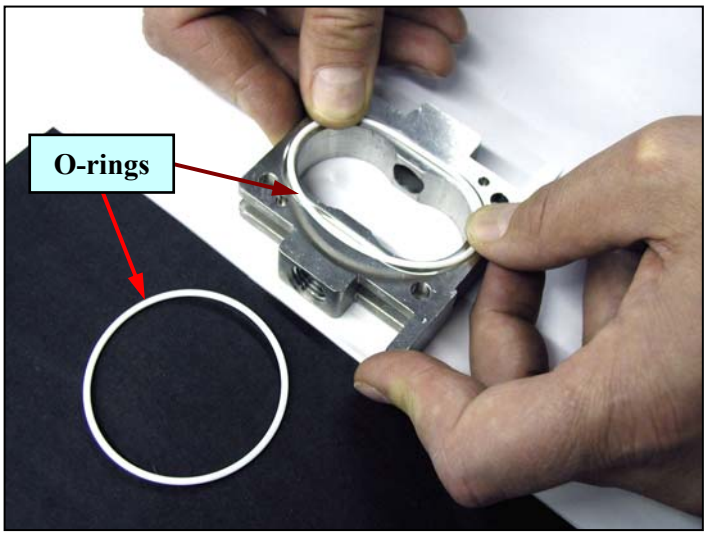


NOTE: The pins should have a slip fit into the housing. The housing pins serve to accurately align the front, center and rear housings.

---

5 Install housing O-rings (5) into the racetrack shaped grooves of the center housing (21).

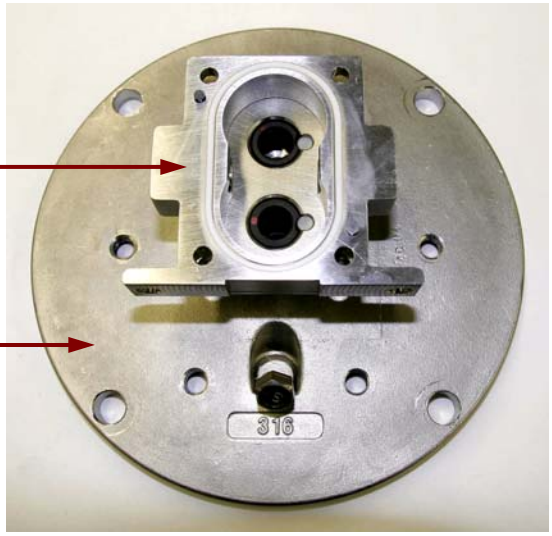
CAUTION! Do not reuse O-rings.



---

6 Place the center housing (21) onto the front housing (8) with orientation as shown.

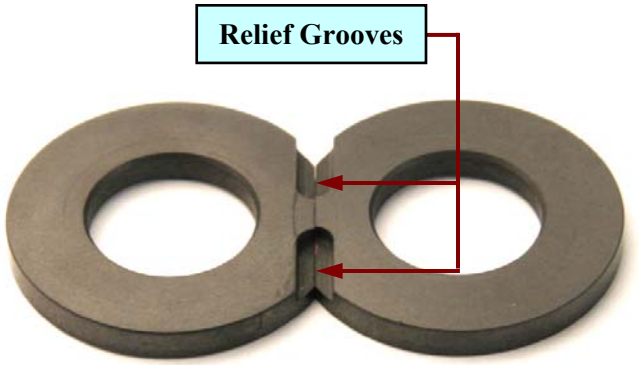
NOTE: Make certain the center housing seats properly over the housing alignment pins in the front housing.



Installation of Wear Plates

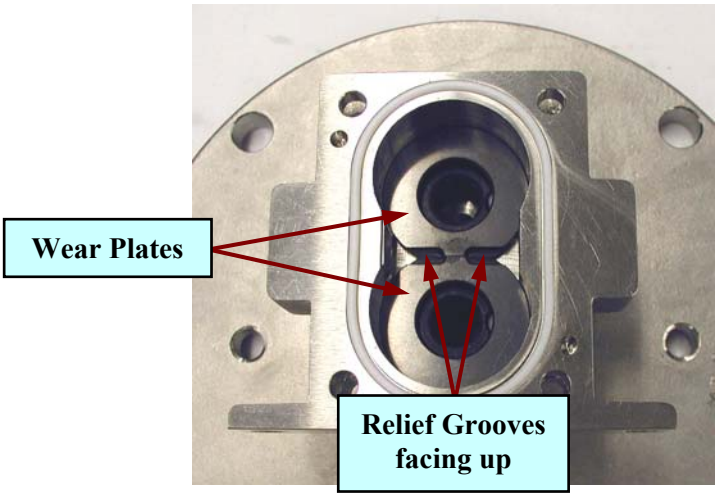
Most Liquiflo wear plates are manufactured with cut-outs or grooves to provide liquid relief paths to reduce hydraulically induced gear separation forces that exist during pump operation. These forces decrease pump life by placing significant loads on the shafts and bearings. To be effective, the relief grooves must face toward the gears.

NOTE: Failure to orient the wear plates properly will reduce the operating life of the pump.



7 Place two wear plates (7) into position, as shown.

NOTE: If the wear plates are relieved, the relief grooves must face up (see photo). This will orient the grooves toward the gears.



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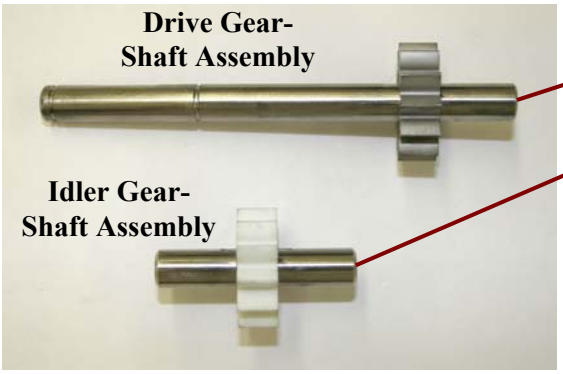
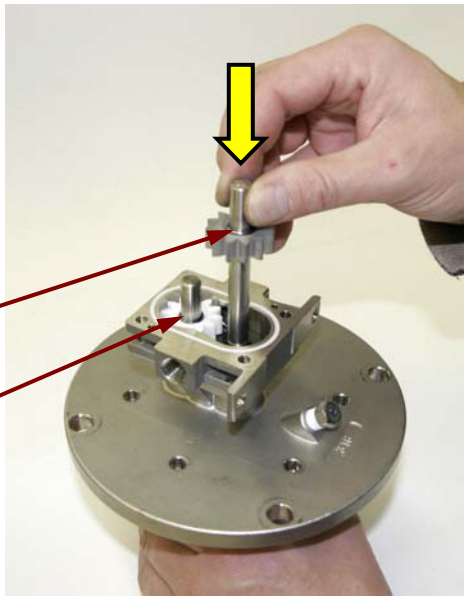
8 Insert the gear-shaft assemblies into the housing, as shown.

NOTE: Liquiflo Repair Kits contain the gears and shafts preassembled, as shown below. If the gears and shafts are not assembled, see **Appendix 5** for the assembly procedure.



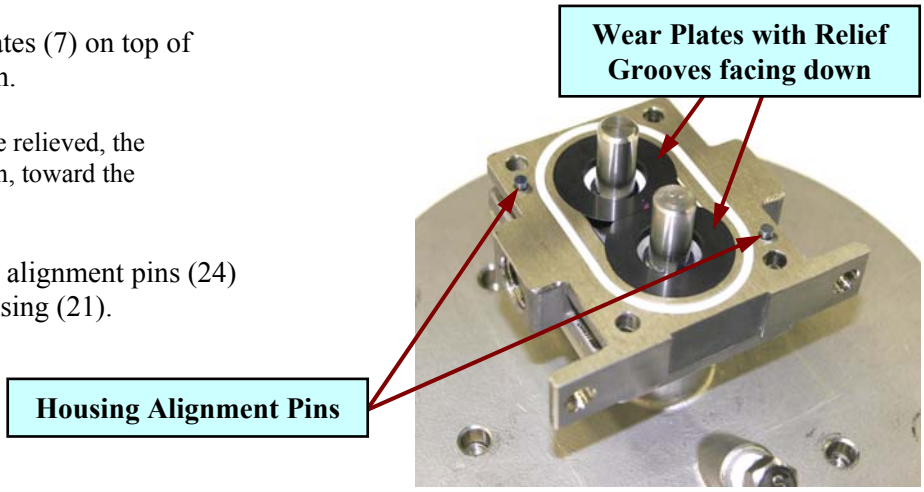


---

9 Place two wear plates (7) on top of the gears, as shown.

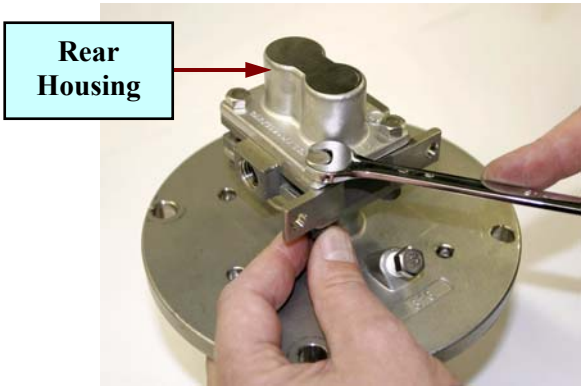
NOTE: If the wear plates are relieved, the relief grooves must face down, toward the gears.

10 Insert two housing alignment pins (24) into the center housing (21).



---

11 Place the rear housing (2) on the center housing (21).



NOTE: Make sure the rear housing seats properly over the alignment pins. If the rear housing has an Internal Bearing Flush (IBF) groove, the groove must be on the discharge side of the pump (see bottom of Page 20).

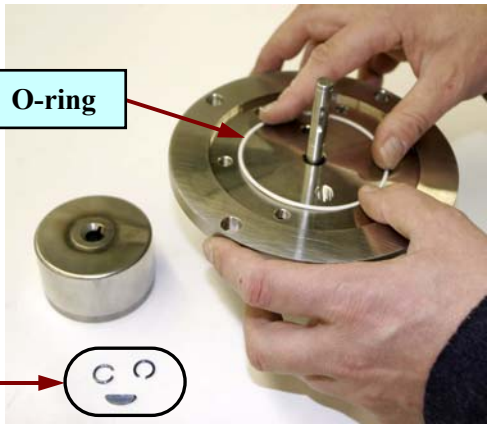
12 Install four sets of bolts (4), nuts (29) and lockwashers (30) into the housing; then tighten the bolts.

NOTE: Apply anti-seize compound to the bolts. Refer to **Appendix 1** for the torque specifications of the fasteners. When tightening the housing bolts, use a star pattern torque sequence on the fasteners to ensure even compression on the O-ring's surface. With Teflon O-rings, repeat this process several times, waiting between retightening. This is necessary because the Teflon will cold flow and require a certain amount of time to properly seat. Continue the process until the bolts no longer require retightening.

---

13 Turn the assembly over and install the containment can O-ring (19) into the circular groove on the front housing.

CAUTION! Do not reuse O-rings.



Installation of Inner Magnet:

14 Install retaining ring (28) onto the drive shaft (20), in the groove that is closest to the front housing (inner groove). This can be done as follows:

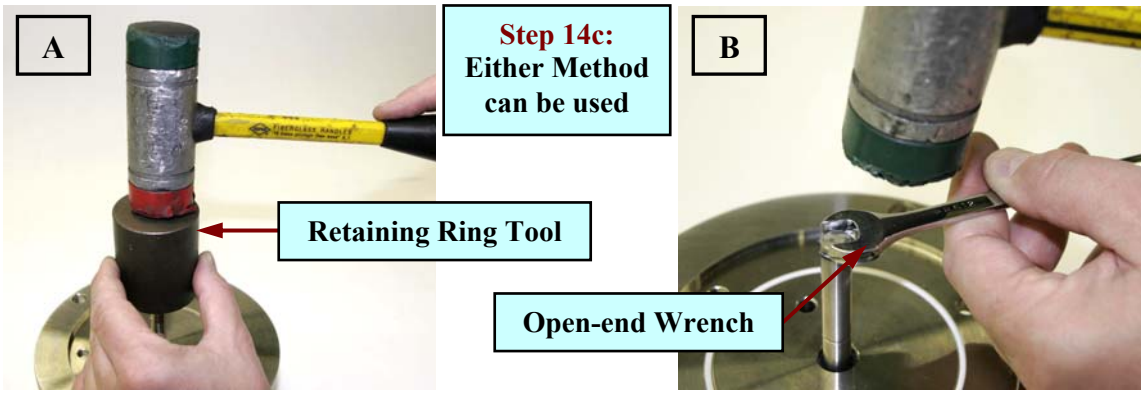
CAUTION! Be careful not to damage the drive shaft during this process.

a. Tap the retaining ring onto the end of the shaft using a rubber mallet.

---

b. Push the retaining ring into the outer groove.

c. Tap the retaining ring down and out of the outer groove by using either:
[**A**] a rubber mallet and specially made tool (see **Appendix 2**), or
[**B**] a rubber mallet and open-end wrench that is slightly larger than the shaft diameter.

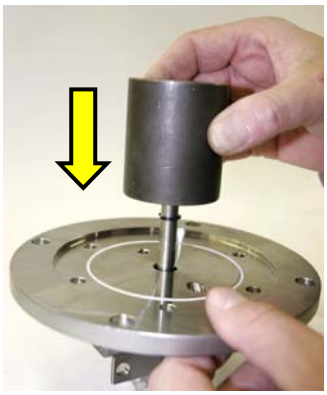


---

d. Push the retaining ring down the shaft and into the inner groove.

CAUTION!
Be careful not to scrape or gouge the drive shaft.

NOTE: Polish out any rough marks on shaft using very fine sand-paper or polishing cloth.



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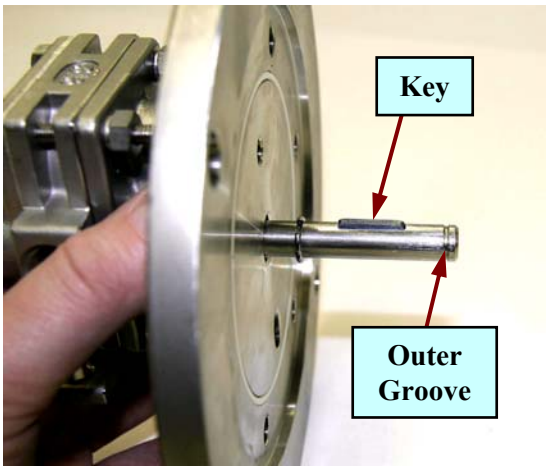
15 Insert key (13) into the drive shaft (20).

NOTE: The straight edge of the key should be parallel to the drive shaft when installing the inner magnet on the shaft.

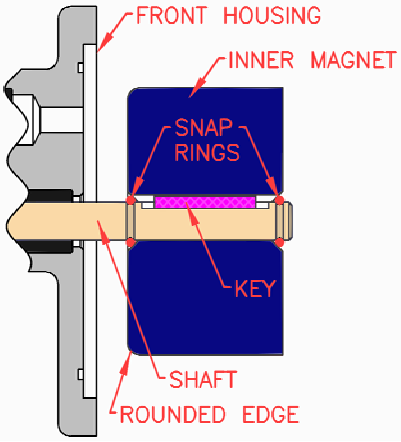


Inner Magnet Installation

Three kinds of inner magnets can be used in the pumps, as shown below. The axial positioning of the inner magnet is automatically set by snap (retaining) rings installed on the drive shaft. The snap rings and key serve to lock the inner magnet on the shaft.

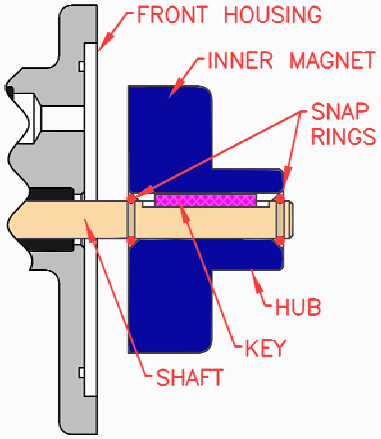
I. MCS, MCB & MCV Inner Magnets:

The **rounded edge** of the inner magnet must face the front housing. (See diagram at right.)



II. MCU Inner Magnet:

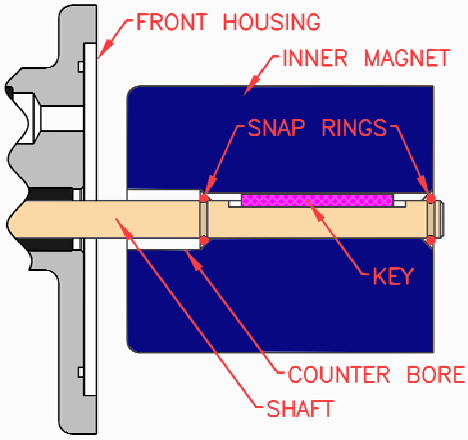
The **hub** of the inner magnet must face away from the front housing. (See diagram at right.)



III. MCA & MCC Inner Magnets:

The **counter-bore** of the inner magnet must face the front housing. (See diagram at right.)

NOTE: These inner magnets require longer drive shafts than those of the other magnets shown above.

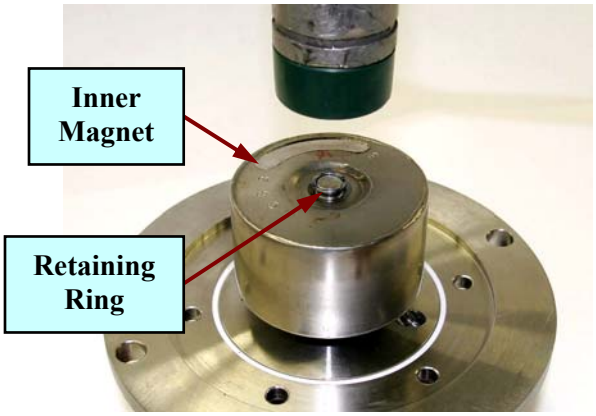


16 Slide the inner magnet (11) onto the drive shaft (20) until it contacts the retaining ring in the inner groove.

NOTE: Install inner magnet with orientation as described on Page 26.

17 Install the second retaining ring (28) into the outer groove, as shown.

NOTE: Use a rubber mallet, as shown, to tap the retaining ring into the outer groove. This will lock the inner magnet assembly on the drive shaft.



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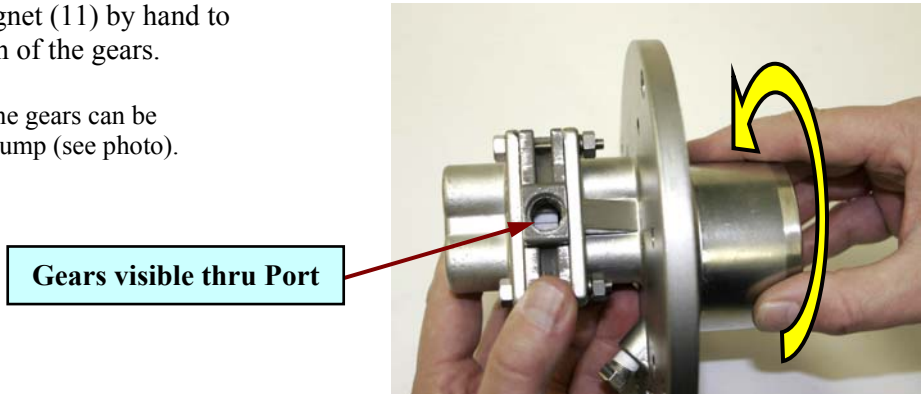
18 Turn the inner magnet (11) by hand to ensure free rotation of the gears.

NOTE: During this check, the gears can be viewed thru the ports of the pump (see photo).



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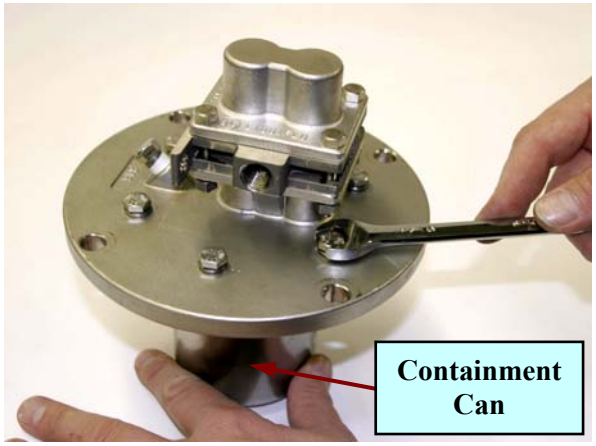
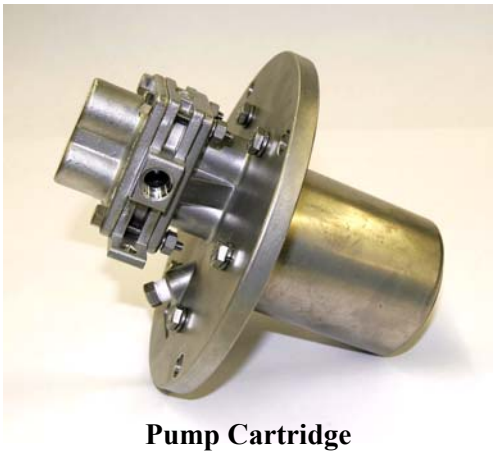
19 Verify that the containment can O-ring is installed (see **Step 13**, Page 24); then attach the containment can (12) to the pump housing using six sets of bolts (18) and lockwashers (32). This completes the **Pump Cartridge** assembly.





Pump Cartridge

NOTE: Apply anti-seize compound to the bolts. Refer to **Appendix 1** for the torque specifications of the fasteners. When tightening the containment can bolts, use a star pattern torque sequence on the fasteners to ensure even compression on the O-ring's surface. With Teflon O-rings, repeat this process several times, waiting between retightening. This is necessary because the Teflon will cold flow and require a certain amount of time to properly seat. Continue the process until the bolts no longer require retightening.

Part B: Outer Magnet-Motor Assembly

The axial positioning of the outer magnet on the motor shaft is critical to pump performance. Improper positioning can cause the outer magnet to rub against the front housing or produce an axial load on the inner magnet, causing premature pump wear. Improper positioning can also cause the outer and inner magnets to decouple. Refer to the diagrams on Page 29 when positioning the outer magnet.

20 Install the outer magnet as follows:

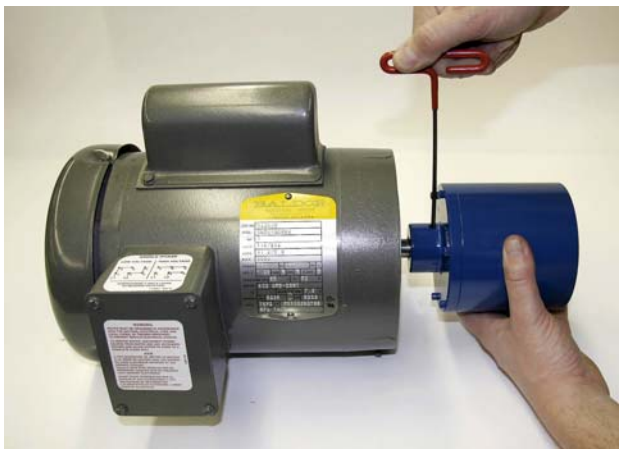
a. Insert motor key into the keyway on the motor shaft.

b. Apply a small amount of anti-seize compound to the motor shaft.

c. Align keyway of the outer magnet's hub (33) with the key on the motor shaft.

d. Slide the outer magnet (10) onto the motor shaft and position the hub as shown on Page 29.

e. Tighten the two setscrews (17) on the hub.



Outer Magnet & Pedestal Part Numbers:

The specific outer magnet and pedestal supplied with the pump is dependent on the motor frame selected; the outer magnet also depends on the magnetic coupling size (see table below). The pump Model Code defines both the Outer Magnet Bore (Motor Frame) and the Magnetic Coupling (see Table 6, Page 6).

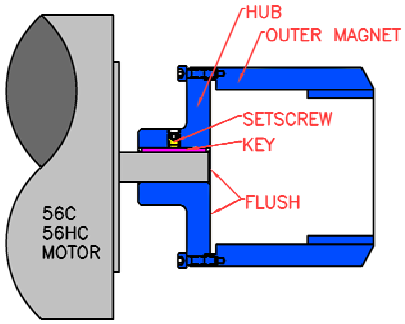
Standard Motor Frame	Motor Shaft Diameter or Outer Magnet Bore Size	Outer Magnet Part Number	Pedestal Part Number
NEMA 56C or 56HC	5/8 in.	SOMCX-5	SP000
NEMA 143TC or 145TC	7/8 in.	SOMCX-7	SP000
NEMA 182TC or 184TC	1-1/8 in.	SOMCX-9	SP000 *
IEC 71 (B5 Flange)	14 mm	SOMCX-71	SP001
IEC 80 (B5 Flange)	19 mm	SOMCX-80	SP002
IEC 90 (B5 Flange)	24 mm	SOMCX-90	SP002

X = **S**, **U**, **A**, **B**, **C** or **V** (Magnetic coupling size; see Table 3, Page 5.)
* Adapter plate required (see Page 29).

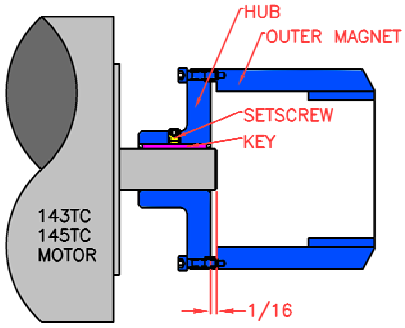
Outer Magnet Installation

The procedure for installing the outer magnet on the motor shaft is dependent on which motor frame is used with the pump. The four standard cases are described below:

I. **NEMA 56C & 56HC Frames:** The end of the motor shaft must be flush with the inner surface of the outer magnet's hub. (See diagram at right.)

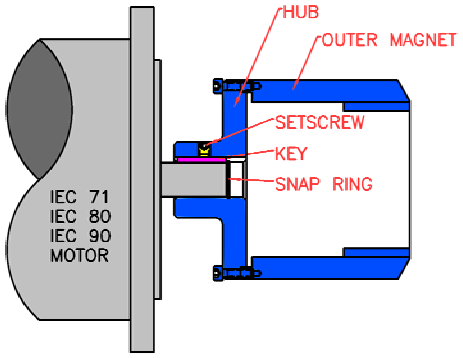


II. **NEMA 143TC & 145TC Frames:** The motor shaft must protrude past the inner surface of the outer magnet's hub by 1/16 in. (1.6 mm).
(See diagram at right.)



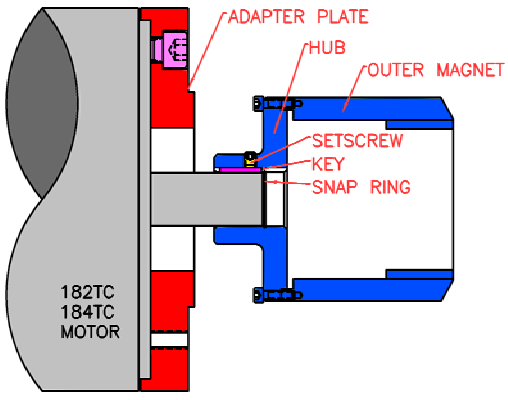
III. **IEC 71, 80 & 90 Frames:** The outer magnet's hub is positioned by a snap ring installed in the hub. The end of the motor shaft must contact the snap ring.
(See diagram at right.)

NOTE: The IEC motor must have a B5 Flange, as shown, to be compatible with the pump mounting bracket.



IV. **NEMA 182TC & 184TC Frames:** An *adapter plate* is required to mount the motor to the pedestal. The outer magnet's hub is positioned by a snap ring installed in the hub. The end of the motor shaft must contact the snap ring.
(See diagram at right.)

NOTE: Complete pumps ordered for use with NEMA 182/184TC motor frames will be supplied with the *adapter plate* (P/N SP0046) and *adapter mounting bolts* (P/N 641105).



Part C: Motor-Pedestal Assembly

21 Install the motor (with outer magnet) to the pedestal (16) using four sets of bolts (15) and lockwashers (34).

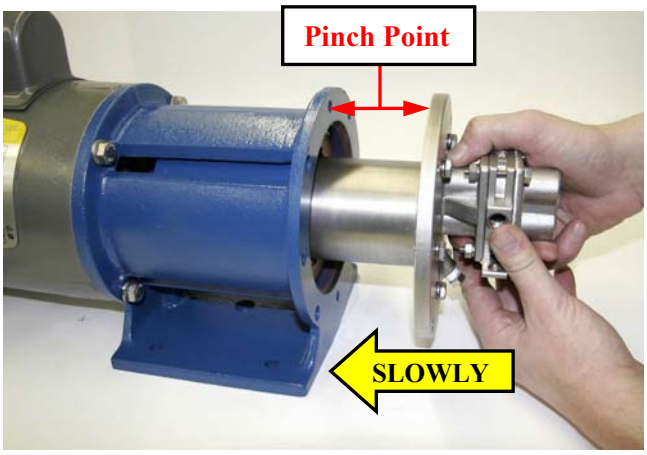
NOTE: The C-faces of the motor and pedestal should mate freely and mount flush. Refer to **Appendix 1** for the torque specifications of the fasteners.

Part D: Cartridge Installation

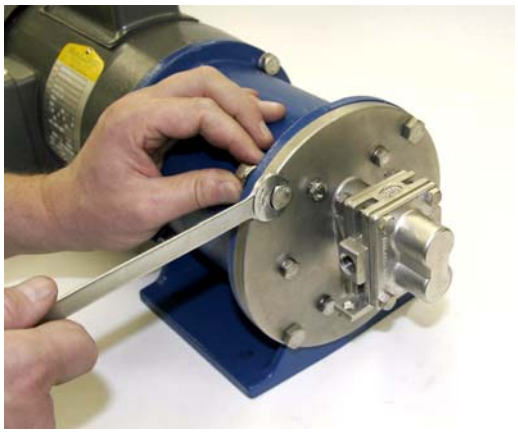
22

CAUTION! Do not place hands or fingers between Pedestal and Cartridge. The Outer and Inner Magnets will suddenly pull together with significant force.

Carefully install the pump cartridge to the pedestal (16) using four sets of bolts (27), nuts (26) and lock-washers (31).



NOTE: Hold the pump cartridge firmly as shown above and then slowly move the containment can inside the outer magnet. The faces of the pedestal and cartridge will mount flush. Refer to **Appendix 1** for the torque specifications of the fasteners.



END OF ASSEMBLY PROCEDURE

Appendix 1: Fastener Torque Specifications

Maximum Torque Specifications for 18-8 Stainless Steel Bolts

Function	Pump Models	Bolt Size	Bolt Type	Qty. (per Pump)	Max Torque Specifications	
					(in-lbs)	(N-m)
Housing Assembly	**31F, 33F, H3F**	10-32 UNF x 1 ½	HHCS	4	31	3.5
	35R, 35F, H5R, H5F	10-32 UNF x 1.80	HHCS	4	31	3.5
	37R, H7N, H7R	1/4-20 UNC x 2 ¼	HHCS	4	75	8.5
	37F, H7F	1/4-20 UNC x 2 ½	HHCS	4	75	8.5
	39R	1/4-20 UNC x 3	HHCS	4	75	8.5
	39F, 311F	1/4-20 UNC x 3 ¾	HHCS	4	75	8.5
Containment Can Assembly	**31F thru 39F, 311F, H3F thru H7F**	1/4-28 UNF x 5/8	HHCS	6	94	10.6
Pump-Pedestal Assembly	**31F thru 39F, 311F, H3F thru H7F**	3/8-16 UNC x 1 ¼	HHCS	4	236	26.7
Motor[1]-Pedestal Assembly	**31F thru 39F, 311F, H3F thru H7F**	3/8-16 UNC x 1	HHCS	4	236	26.7
Motor[2]-Adapter Assembly	**31F thru 39F, 311F, H3F thru H7F**	1/2-13 UNC x 1	SHCS	4	517	58.4
Adapter[2]-Pedestal Assembly	**31F thru 39F, 311F, H3F thru H7F**	3/8-16 UNC x 1	HHCS	4	236	26.7

[1] NEMA 56C, 56HC, 143TC & 145TC motor frames
[2] NEMA 182TC & 184TC motor frames

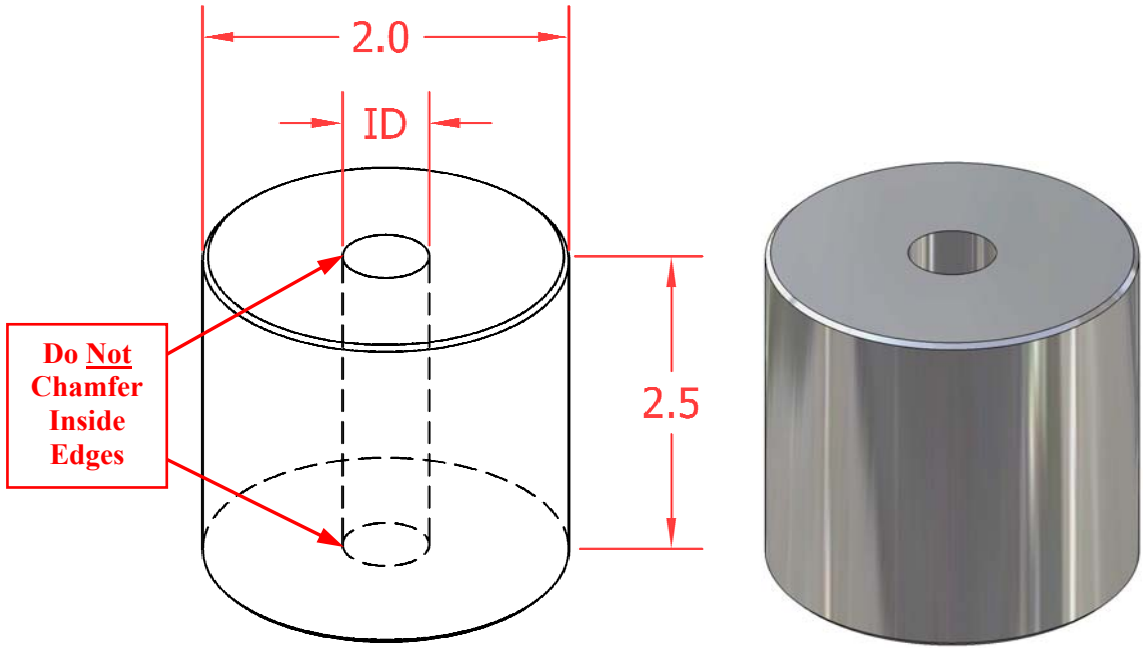
HHCS = Hex Head Cap Screw
SHCS = Socket Head Cap Screw

Appendix 2: Retaining Ring Tool Specifications

The following tool is recommended for the efficient and safe installation or removal of the retaining rings used in the pump. It should be manufactured from a hard material, such as steel.

Tool Dimensional Specifications (inches)

Tool #	For Pump Models	ID	ID Tolerance
1	**31F, 33F, 35R, 35F & H3F**	.378	+/- .001
2	**37R, 37F, 311F, H5R & H5F**	.503	+/- .001
3	**39R, 39F, H7N, H7R & H7F**	.628	+/- .001



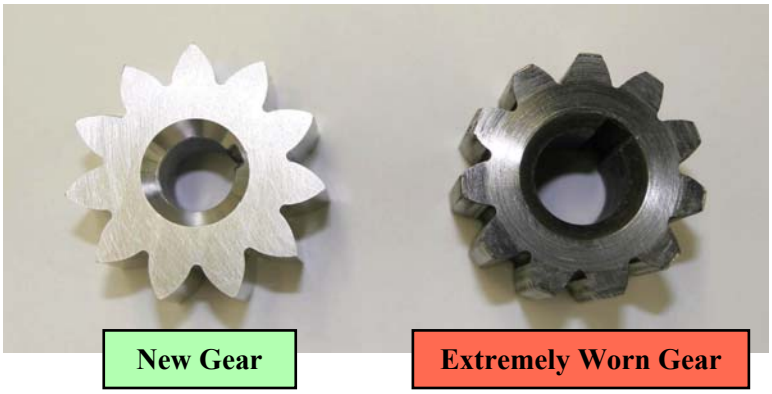
NOTE: The retaining ring tool is especially useful when assembling the gears on the drive and idler shafts (see **Appendix 5**). It can also be used to facilitate installation of the inner magnet on the drive shaft (see **Section 5.4**, Page 25).

Appendix 3: Wear Allowances

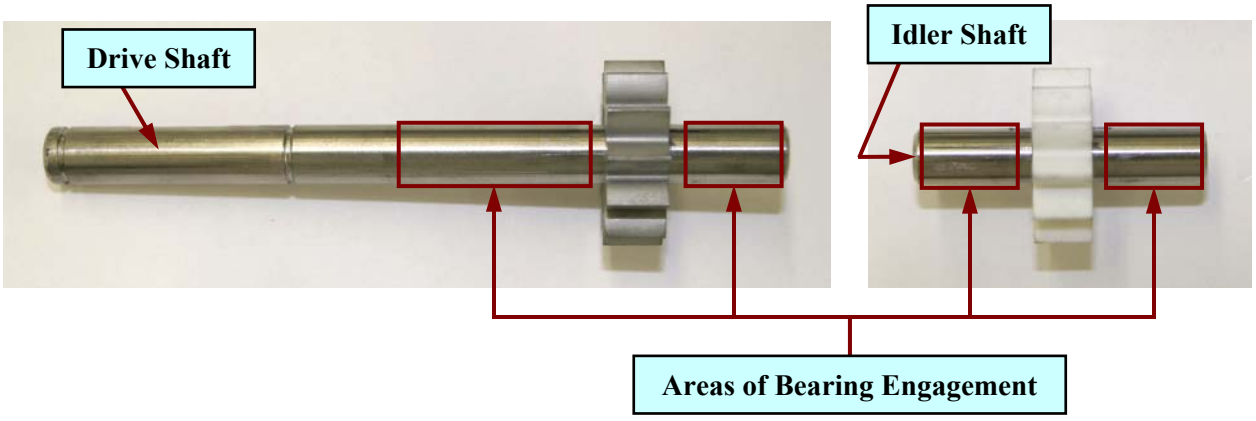
When a pump requires maintenance, a convenient way to restore the pump to like-new condition is to use a repair kit. The repair kit contains all *internal wear parts* as well as O-rings, retaining rings, bearing lock pins, housing alignment pins and keys.

In some cases, only certain parts may need to be replaced. The primary wear parts of the pump are the gears, shafts, wear plates and bearings. The center housing (secondary wear part) may also incur physical wear by contact with the gears caused by excessively worn bearings. (Note: the center housing is not included in a standard repair kit.) These wear parts can be reused if they are in acceptable condition. O-rings and retaining rings should not be reused. The following used parts should be inspected and evaluated for reuse based on the specifications given in the **Wear Allowances Chart** (see Page 35):

Gears: Spur gears should have a uniform tooth profile on both the leading and trailing edges. If the outer diameter of the gear is worn, pumping performance will degrade. Gears with minor wear should be evaluated for reuse by measuring the outer diameter and comparing it to the minimum diameter specification given in the Wear Allowances Chart. Gears with obvious major wear, such as flattened teeth or other significant wear on the profile, should be replaced (see photo below).

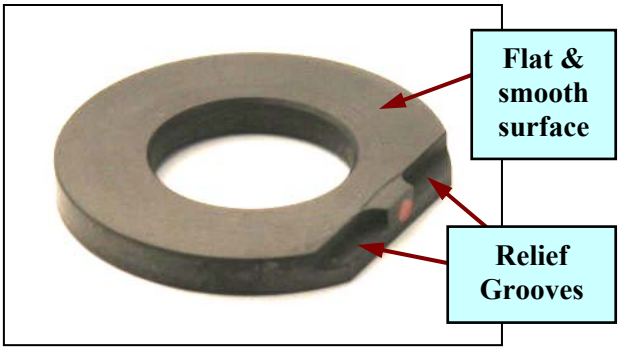


Shafts: The area of the shaft that is engaged in the bearings will wear over time depending on the service conditions and materials of construction (see photos below). Hard-coated shafts are available to minimize or eliminate wear of the shaft surfaces. Worn shafts may allow the gears to contact the center housing and accelerate both gear and center housing wear. The shaft journal area should be round and have a minimum diameter as specified in the Wear Allowances Chart.



Appendix 3: Wear Allowances (Continued)

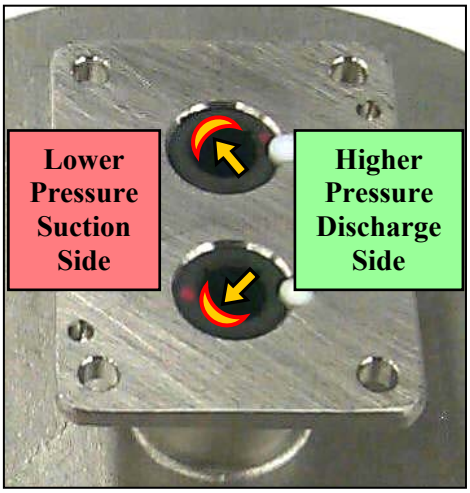
Wear Plates: This is a sacrificial part of the pump designed to protect the front and rear housings from wear by continual contact with the sides of the gears. Erosion of the wear plates increase clearances causing slip to increase. This results in a reduction in pump performance. Wear plates should have smooth surfaces and meet the minimum thickness requirements given in the Wear Allowances Chart. (Note: Most Liquiflo wear plates are manufactured with cut-outs or relief grooves to minimize hydraulically induced gear separation forces during pumping. These *relieved wear plates* increase pump life by reducing loads on bearings and shafts. A typical relieved wear plate is shown below.)



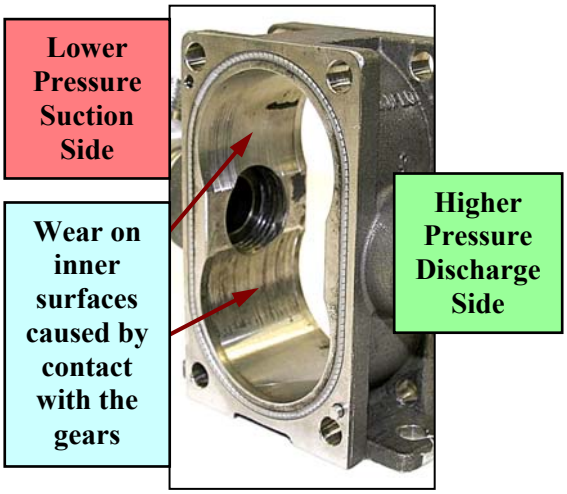
Typical Relieved Wear Plate

Measuring Wear Plate Thickness

Bearings: The 3-Series and H-Series pumps use sleeve-type bearings that are also known as *journal bearings*. These bearings are designed to support the shafts and precisely position the gears inside the housing. Worn bearings will eventually allow the rotating gears to contact the center housing, causing wear and eventual failure of both of these components. (See photo at below left for the typical wear pattern of the bearings.) If any wear of the bearings is observed, they should be replaced. The Wear Allowances Chart gives the maximum inner diameter that is acceptable for worn bearings.



Typical Wear Pattern of Bearings



Typical Wear Pattern of Center Housing

Center Housing: The typical failure mode for the center housing is from contact with the rotating gears, caused by extreme wear of the bearings and shafts. Evidence of contact or slight wear on the inside surfaces can be expected. However, if deep grooves or excessive wear is observed, the center housing should be replaced. (See photo at above right for the typical wear pattern of the center housing.) Reusing a worn center housing will cause pump performance to be lower than expected because of increased slip.

Appendix 3: Wear Allowances (Continued)

Wear Allowances Chart (Units: inches)

Pump Series	Pump Model	Gears		Shafts		Wear Plates		Bearings	
		Nom. O.D.	Min O.D.	Nom. O.D.	Min O.D.	Nom. Thick.	Min Thick.	Nom. I.D.	Max I.D.
3-Series	31F	1.163	1.158	0.375	0.373	0.250	0.247	0.375	0.378
	33F	1.163	1.158	0.375	0.373	0.125	0.122	0.375	0.378
	35R	1.163	1.158	0.375	0.373	0.250	0.247	0.375	0.378
	35F	1.163	1.158	0.375	0.373	0.125	0.122	0.375	0.378
	37R	1.711	1.705	0.500	0.498	0.125	0.122	0.500	0.503
	37F	1.711	1.705	0.500	0.498	0.125	0.122	0.500	0.503
	39R	1.711	1.705	0.625	0.623	0.125	0.122	0.625	0.628
	39F	1.711	1.705	0.625	0.623	0.125	0.122	0.625	0.628
	311F	1.711	1.705	0.500	0.498	0.125	0.122	0.500	0.503
H-Series	H3F	1.163	1.158	0.375	0.373	0.125	0.122	0.375	0.378
	H5R	1.163	1.158	0.500	0.498	0.250	0.247	0.500	0.503
	H5F	1.163	1.158	0.500	0.498	0.125	0.122	0.500	0.503
	H7N	1.711	1.705	0.625	0.623	0.312	0.309	0.625	0.628
	H7R	1.711	1.705	0.625	0.623	0.125	0.122	0.625	0.628
	H7F	1.711	1.705	0.625	0.623	0.125	0.122	0.625	0.628

O.D. = Outer Diameter **I.D.** = Inner Diameter

NOTES:

1 Pump models that are not highlighted in the above table have gears with an even number of teeth. The diameter for these gears is measured from the tip of one tooth to the tip of the opposite tooth (see **Photo 1**). This measurement method gives the true diameter of the gears.

2 Pump models that are highlighted in the above table have gears with an odd number of teeth. Because no two teeth have tips that coincide with the actual gear diameter, this makes the true gear diameter difficult to measure. A practical field method for determining gear wear is to measure the "three-point diameter" of the gear. That is, place one jaw of the caliper on the tip of one tooth and the other jaw on the tips of both opposite teeth and record the distance (see **Photo 2**). The highlighted diameter values are based on this measurement method and are less than the true gear diameters. (For the true nominal gear diameters, see the chart on Page 39.)

3 All diameter values listed in the above table are based on standard (untrimmed) parts. Parts requiring viscosity or temperature trims will have dimensions based on the application. Consult factory.

Photo 1

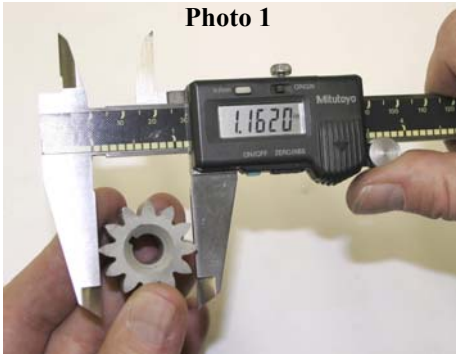
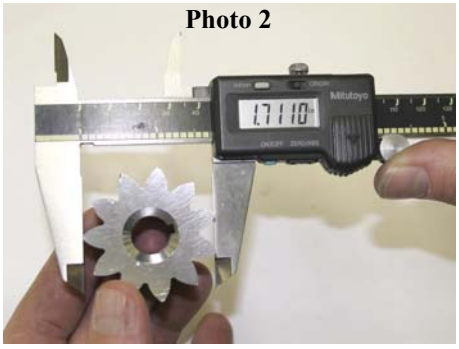
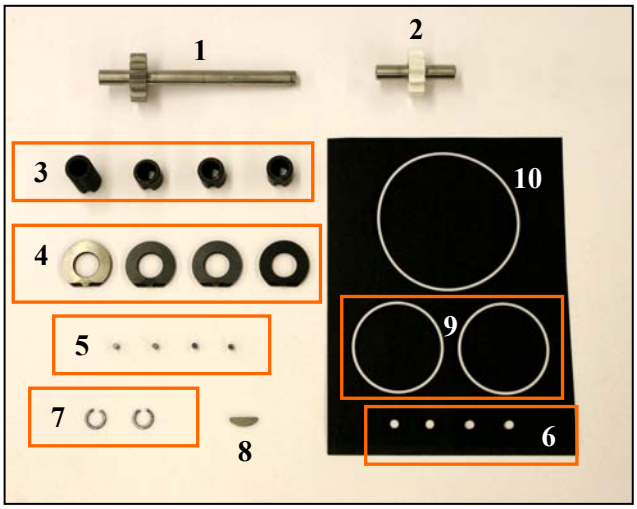


Photo 2



Appendix 4: Pump Parts List

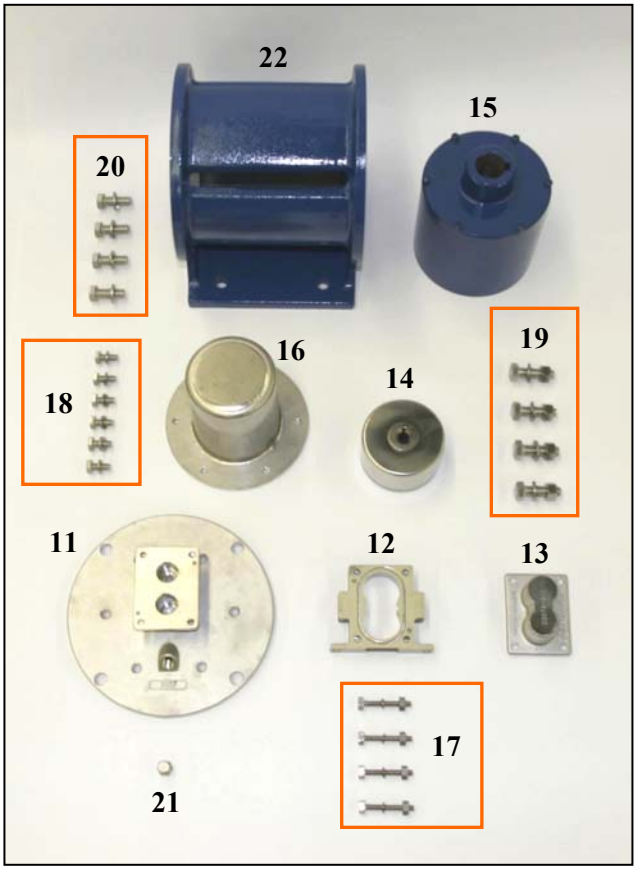
Repair Kit parts (and quantities):



1 Drive gear-shaft assembly (1)
2 Idler gear-shaft assembly (1)
3 Bearings (4)
4 Wear plates (4)
5 Housing alignment pins (4)
6 Bearing lock pins (4)
7 Retaining rings for inner magnet (2)
8 Key for inner magnet (1)
9 O-rings for housing (2)
10 O-ring for containment can (1)

NOTE: The gears and shafts come preassembled in a standard repair kit, as shown above. These parts can also be purchased separately. For the procedure for assembling the gears and shafts, see **Appendix 5**.

Other assembly parts (and quantities):

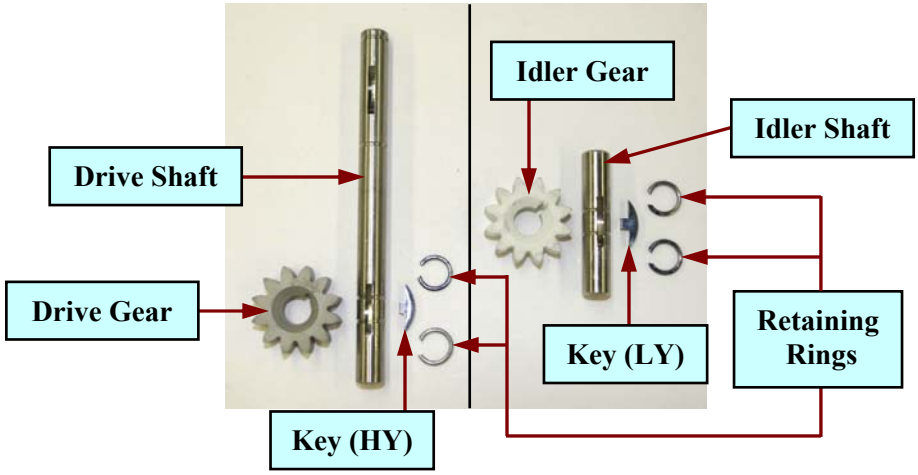


11 Front housing (1)
12 Center housing (1)
13 Rear housing (1)
14 Inner magnet (1)
15 Outer magnet (1)
16 Containment can (1)
17 Screws, nuts and lockwashers for housing assembly (4 sets)
18 Screws & lockwashers for containment can assembly (6 sets)
19 Screws, nuts & lockwashers for cartridge-pedestal assembly (4 sets)
20 Screws & lockwashers for motor-pedestal assembly (4 sets)
21 1/8” NPT plug (1)
22 Pedestal (1)

Appendix 5: Gear-Shaft Assembly

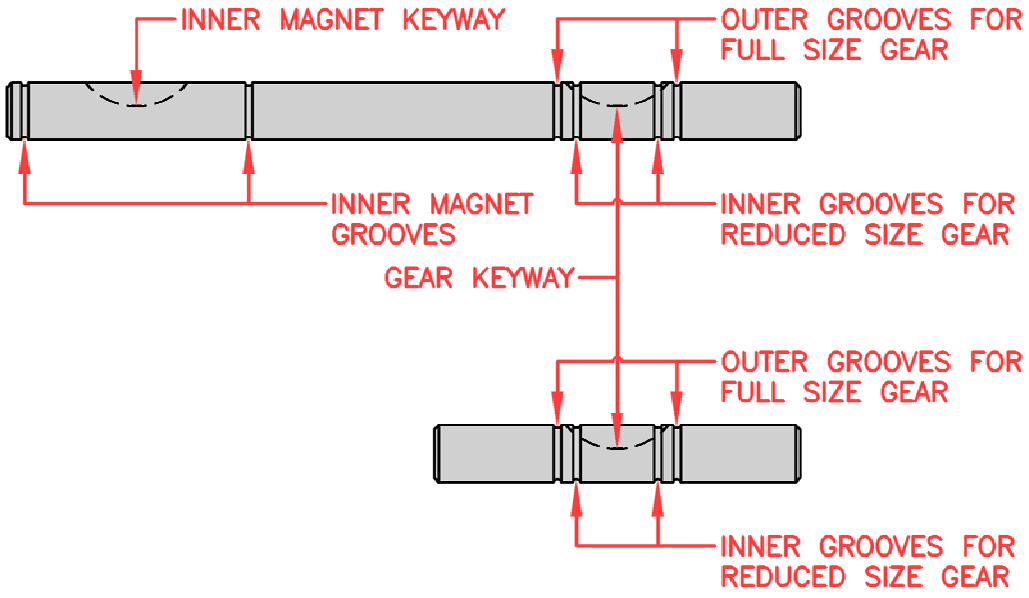
Parts List for Gear-Shaft Assemblies

Drive Gear-Shaft Parts		Idler Gear-Shaft Parts	
Part	**Quantity**	**Part**	**Quantity**
Drive Gear	1	Idler Gear	1
Drive Shaft	1	Idler Shaft	1
Key	1	Key	1
Retaining Ring	2	Retaining Ring	2



Description of Parts:

Shafts: As shown above, the pump contains two kinds of shafts: the *drive shaft* and the *idler shaft*. Both shafts have retaining ring grooves and a keyway for positioning the gears. The drive shaft also has a set of retaining ring grooves and keyway on one end for the inner magnet. The gears are positioned on the shafts using two retaining rings per gear. Depending on the pump model, some shafts may contain an inner and outer set of grooves to fit both full (F) and reduced (R) size gears. (See diagram below.)


INNER MAGNET KEYWAY
OUTER GROOVES FOR FULL SIZE GEAR
INNER MAGNET GROOVES
INNER GROOVES FOR REDUCED SIZE GEAR
GEAR KEYWAY
OUTER GROOVES FOR FULL SIZE GEAR
INNER GROOVES FOR REDUCED SIZE GEAR

Appendix 5: Gear-Shaft Assembly (Continued)

To identify the pump shafts, refer to the following chart:

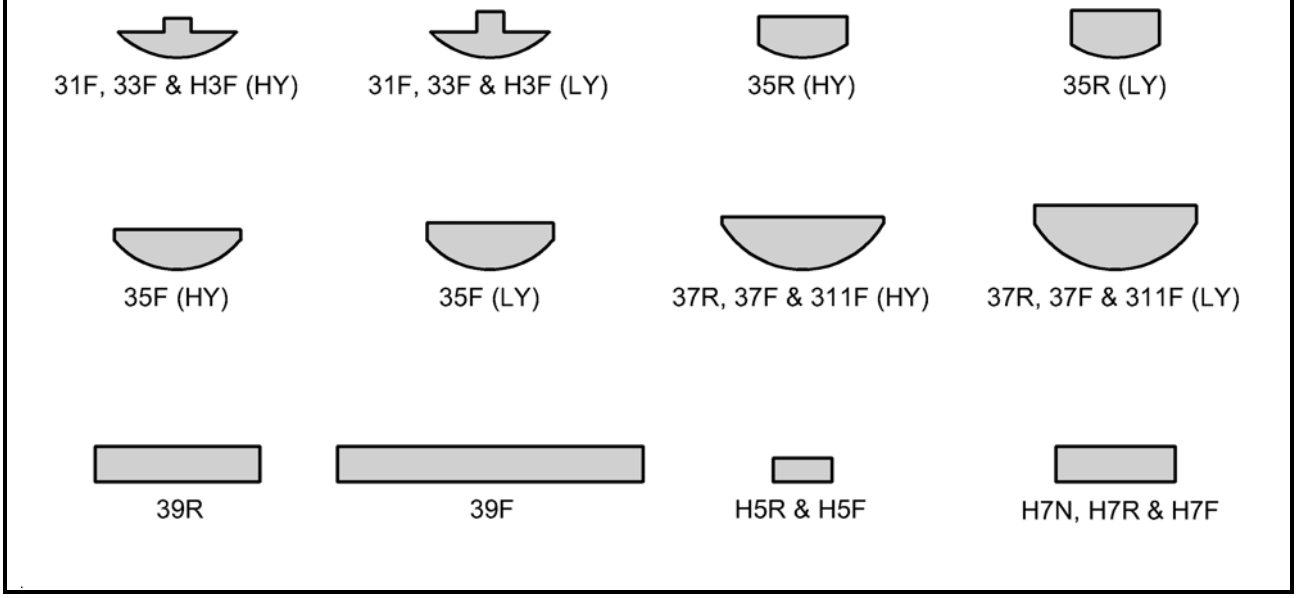
Shaft Identification Chart

Pump Series	For Pump Models	Shaft Diameter	Drive Shaft Length (1)	Drive Shaft Length (2)	Idler Shaft Length	# of Gear Retaining Ring Grooves
	UNITS:	in	in	in	in	—
3-Series	31F & 33F	3/8	4.71	6.24	1.91	2
	35R & 35F	3/8	5.20	6.73	2.40	4
	37R & 37F	1/2	6.47	8.00	3.81	4
	39R	5/8	6.96	8.49	4.31	2
	39F	5/8	7.71	9.24	5.06	2
	311F	1/2	7.71	9.24	5.06	2
H-Series	H3F	3/8	4.71	6.24	1.91	2
	H5R & H5F	1/2	5.20	6.68	2.40	4
	H7N	5/8	6.46	—	3.81	2
	H7R & H7F	5/8	6.46	7.86	3.81	4

1 - For MCS, MCU, MCB & MCV inner magnets. **2** - For MCA & MCC inner magnets

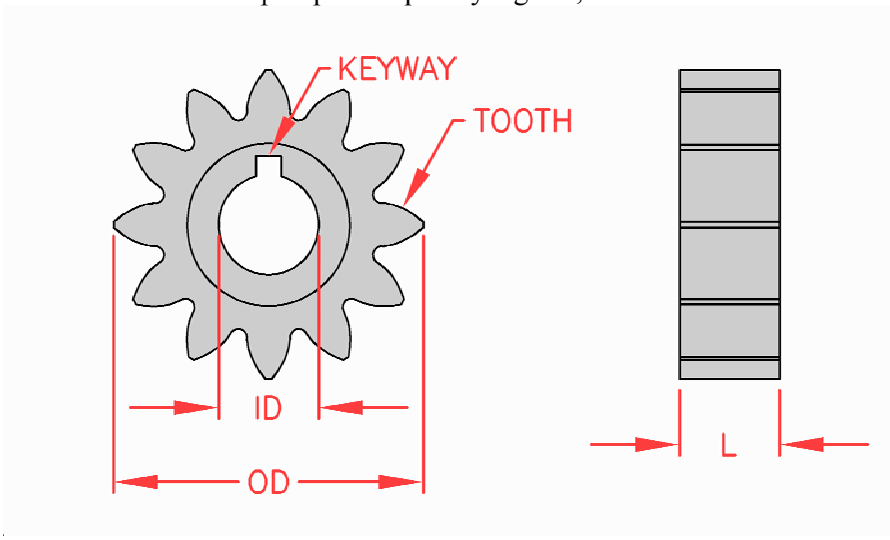
Keys: Three types of gear keys are used in the pumps: High-yield (HY), low-yield (LY) and rectangular. For Models 31F thru 37F, 311F and H3F, high-yield keys are used for all gear materials except Teflon; low-yield keys are used only for Teflon gears. (Note: High-yield keys have a lower height than low-yield keys.) For Models 39R, 39F and H5R thru H7F, rectangular keys are used for all gears. To identify the keys, use the following chart:

Key Identification Chart **Note:** Key profiles are shown in actual size.



Appendix 5: Gear-Shaft Assembly (Continued)

Gears: The 3-Series and H-Series pumps use spur style gears, as shown below:



To identify the gears, use the following chart:

Gear Identification Chart

Pump Series	Pump Model	Gear Outer Diameter (OD)	Gear Inner Diameter (ID)	Gear Length (L)	# of Teeth
	UNITS:	in	in	in	—
3-Series	31F	1.163	3/8	1/8 (3/8 Hub)	12
	33F	1.163	3/8	3/8	12
	35R	1.163	3/8	5/8	12
	35F	1.163	3/8	7/8	12
	37R	1.750	1/2	1	11
	37F	1.750	1/2	1 ¼	11
	39R	1.750	5/8	1 ¾	11
	39F	1.750	5/8	2 ½	11
	311F	1.750	1/2	2 ½	11
H-Series	H3F	1.163	3/8	3/8	12
	H5R	1.163	1/2	5/8	12
	H5F	1.163	1/2	7/8	12
	H7N	1.750	5/8	5/8	11
	H7R	1.750	5/8	1	11
	H7F	1.750	5/8	1 ¼	11

Retaining Rings: The retaining rings are used to position the gears on the shafts. They should always be replaced when repairing the pump.

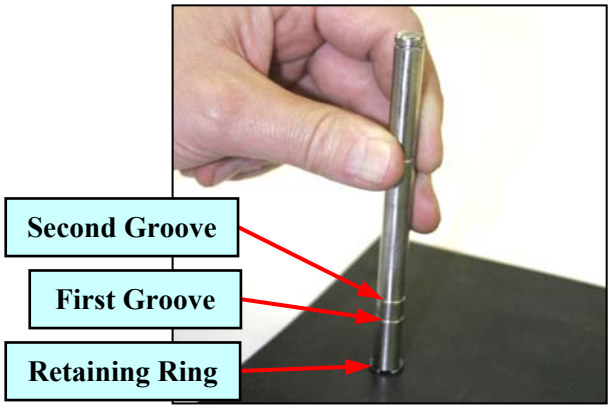
Appendix 5: Gear-Shaft Assembly (Continued)

Assembly Procedure:

CAUTION! Be careful not to damage the shafts.

1 Place one retaining ring (28) on a firm rubber mat and then place the shaft over the retaining ring, as shown.

NOTE: The pump shaft shown is the drive shaft for a 33F-MC pump. This shaft has a 3/8" diameter and two gear retaining ring grooves (see Shaft Identification Chart on Page 38).



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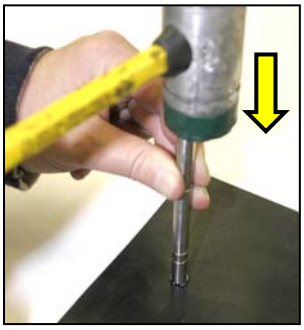
2 Strike the top end of the shaft with a rubber mallet to force the retaining ring onto the bottom end of the shaft, as shown.



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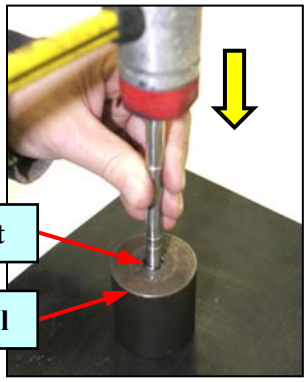
3 Using the retaining ring tool, tap the shaft to slide the retaining ring into the first groove.

NOTE: See **Appendix 2** for specifications on producing the retaining ring tool.



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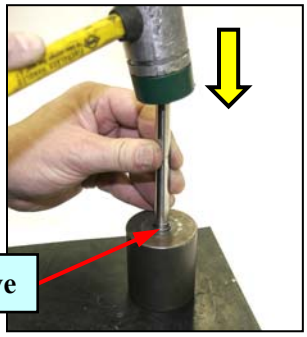
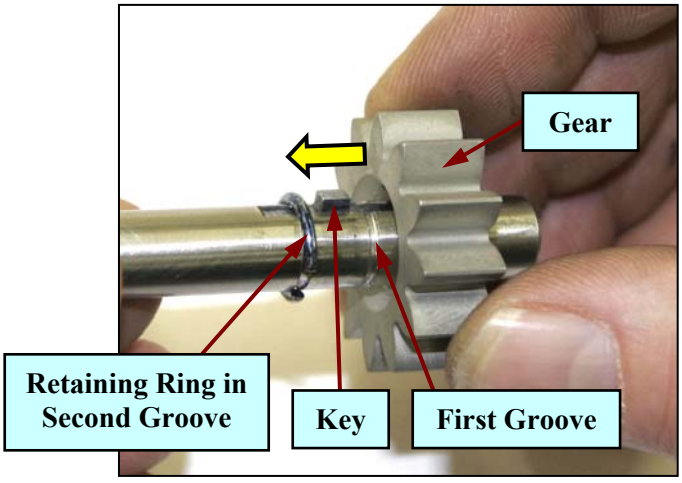
4 Strike the end of the shaft to dislodge the retaining ring from the first groove; then slide the retaining ring into the second groove by tapping the shaft.



Appendix 5: Gear-Shaft Assembly (Continued)

5 Install the key (23A) and gear (22) on the shaft.

NOTE: The gear shown is a 33F metallic drive gear. This gear requires a HY-type key (see the section on Keys on Page 38.) Align the keyway of the gear with the key on the shaft; then slide the gear over the key until the gear contacts the retaining ring.



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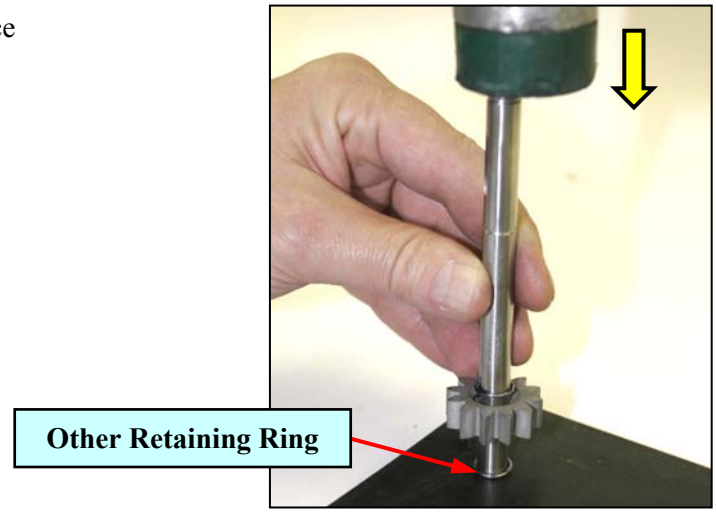
6 While holding the gear in place, force the other retaining ring (28) onto the end of the shaft by striking the shaft with the rubber mallet, as shown.



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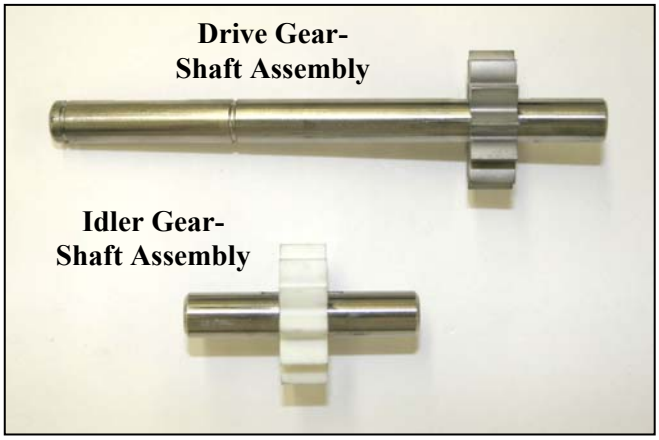
7 Slide the retaining ring into the first groove. This will lock the gear on the shaft.

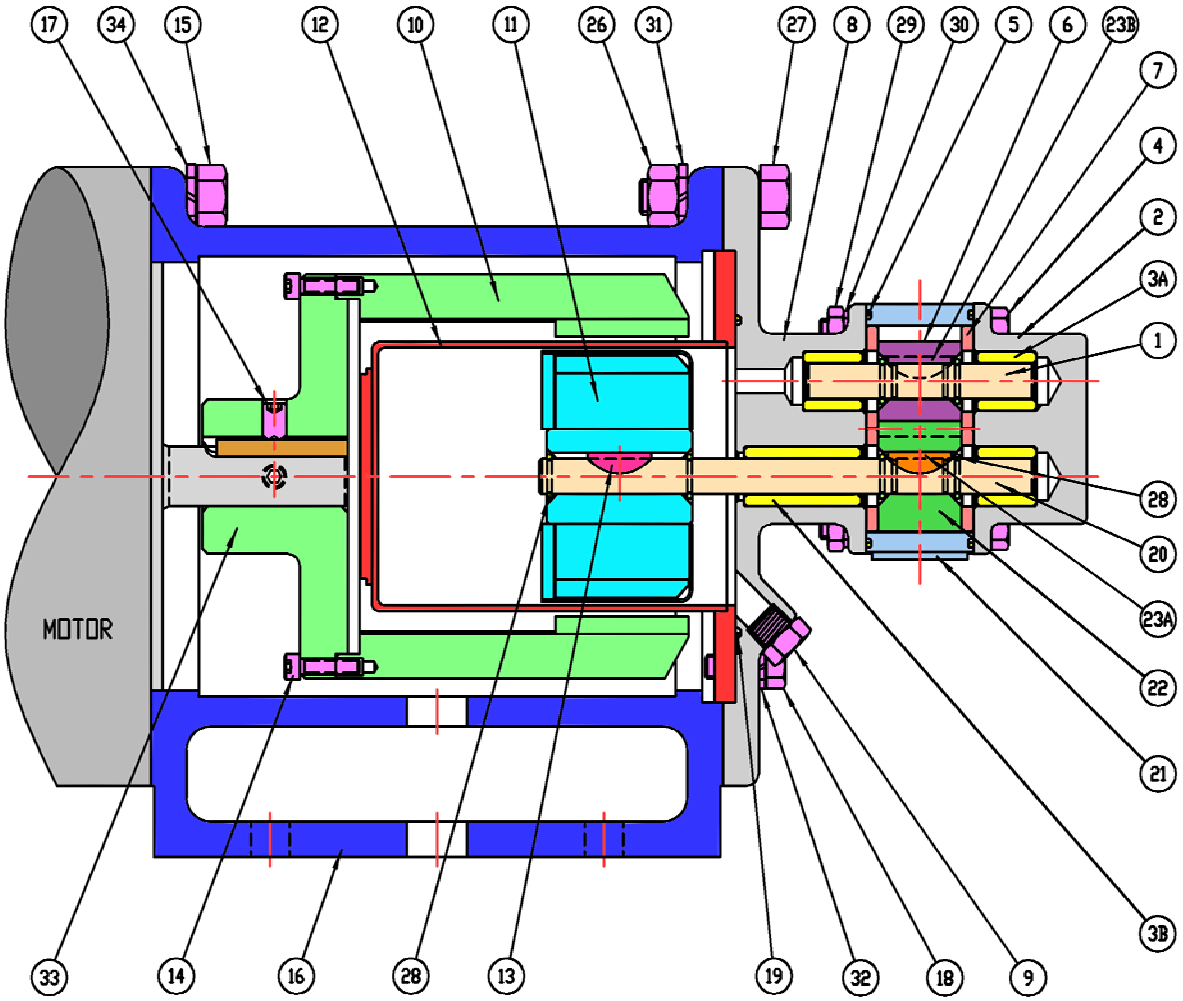
NOTE: As a check, pull the gear by hand along the axis of the shaft to make sure it is securely locked into position.



END OF PROCEDURE

Appendix 6: Reference Drawings

Pump Cross-Sectional Drawing



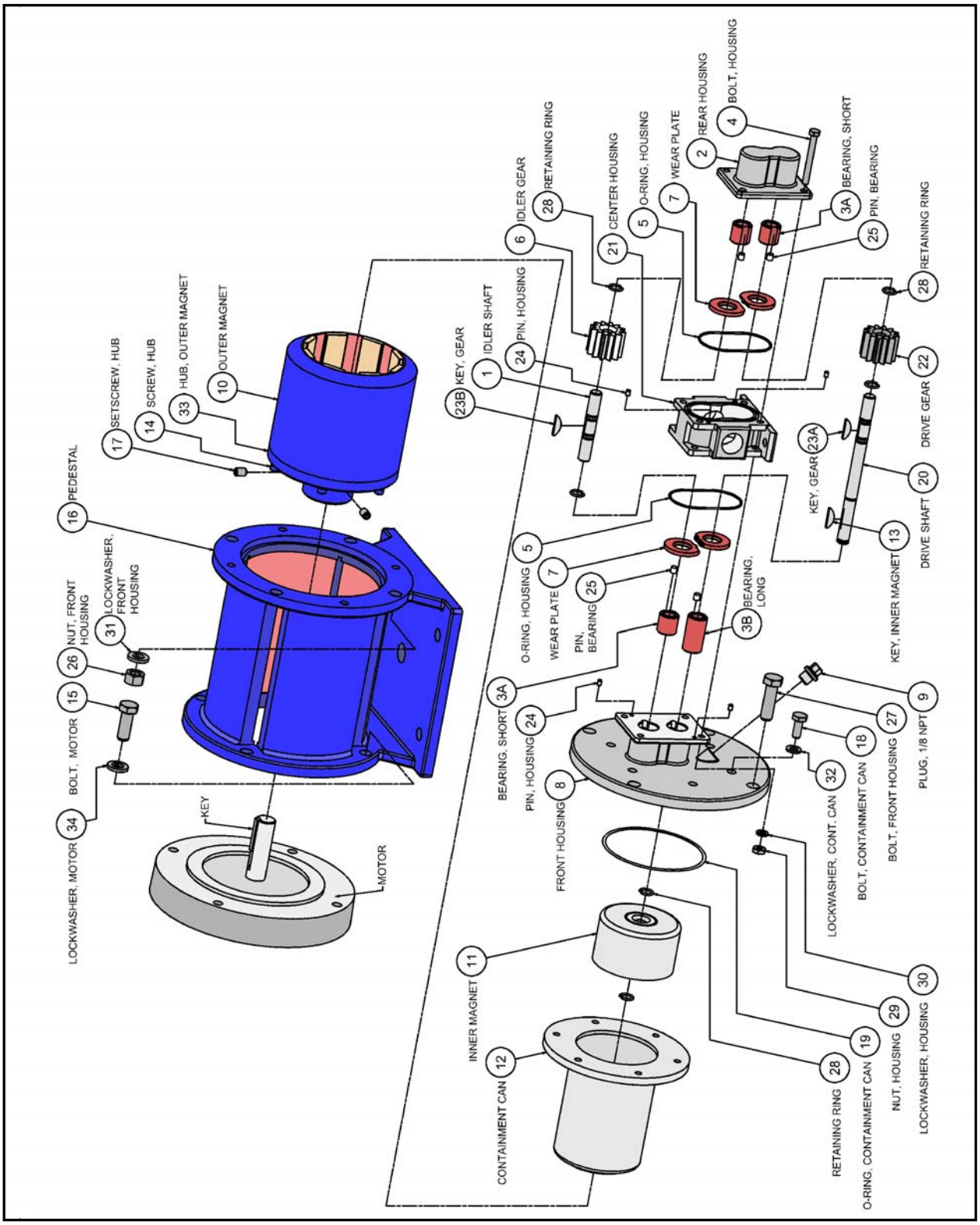
Item #	Description	Qty.	Item #	Description	Qty.
1	Idler Shaft	1	20	Drive Shaft	1
2	Rear Housing	1	21	Center Housing	1
3A	Bearing, Short *	3	22	Drive Gear	1
3B	Bearing, Long *	1	23A	Key, Drive Gear	1
4	Bolt, Housing (HHCS) **	4	23B	Key, Idler Gear	1
5	O-ring, Housing	2	24	Pin, Housing Alignment (Not Shown)	4
6	Idler Gear	1	25	Pin, Bearing Lock (Not Shown)	4
7	Wear Plate	4	26	Nut, Front Housing (3/8-16)	4
8	Front Housing	1	27	Bolt, Front Housing (3/8-16 x 1 ¼ HHCS)	4
9	Plug, 1/8 NPT	1	28	Retaining Ring	6
10	Outer Magnet (Assembly)	1	29	Nut, Housing **	4
11	Inner Magnet (Assembly)	1	30	Lockwasher, Housing **	4
12	Containment Can	1	31	Lockwasher, Front Housing (3/8)	4
13	Key, Inner Magnet	1	32	Lockwasher, C. Can (1/4)	6
14	Screw, Hub (8-32 x 5/8 SHCS)	6	33	Hub, Outer Magnet	1
15	Bolt, Motor (3/8-16 x 1 HHCS)	4	34	Lockwasher, Motor (3/8)	4
16	Pedestal (Mounting Bracket)	1	35	Adapter Plate - NEMA 182/184TC Motor (Not Shown)	1
17	Setscrew, Hub (1/4-28 x 3/8 SHSS-CP)	2			
18	Bolt, C. Can (1/4-28 x 5/8 HHCS)	6	36	Bolt, Adapter (1/2-13 x 1 SHCS) (Not Shown)	4
19	O-ring, Containment Can	1			

* Pump Models 37, 39, 311 & H7 each have four bearings of equal size.

** See Page 31 for bolt size.

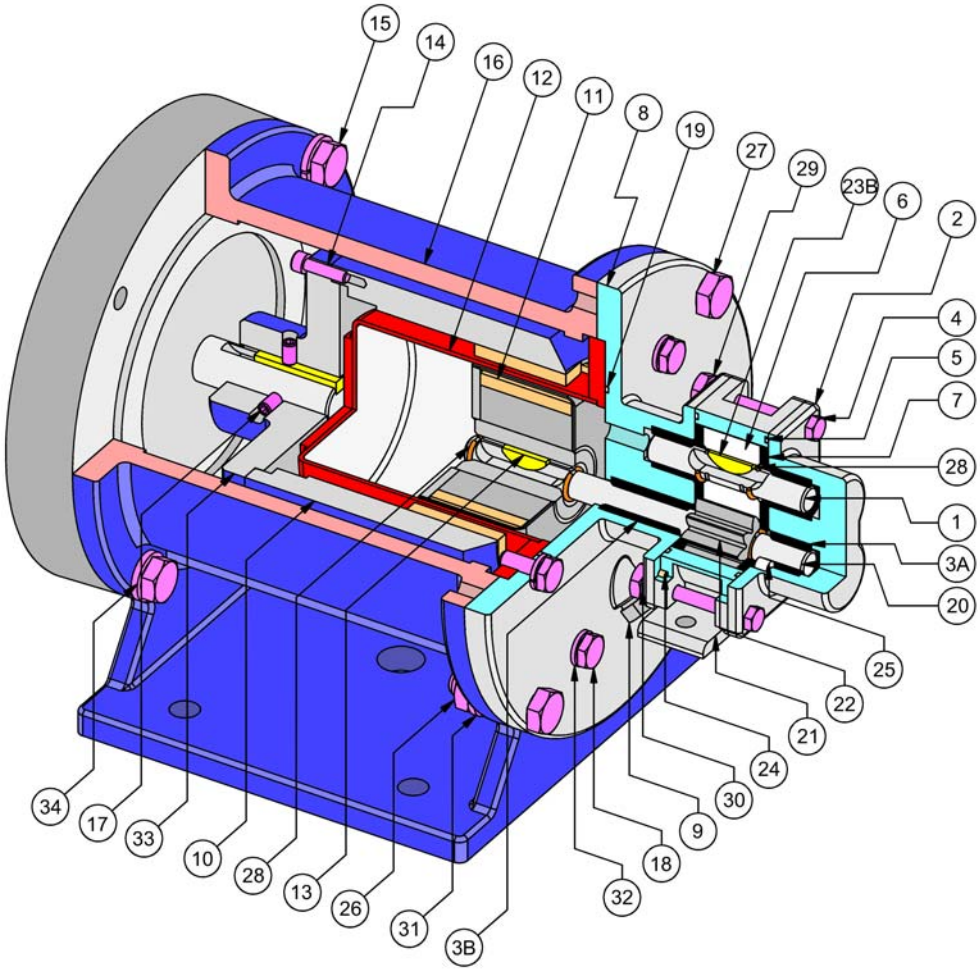
Appendix 6: Reference Drawings (Continued)

Pump Exploded View Drawing



Appendix 6: Reference Drawings (Continued)

Pump Cutaway View Drawing



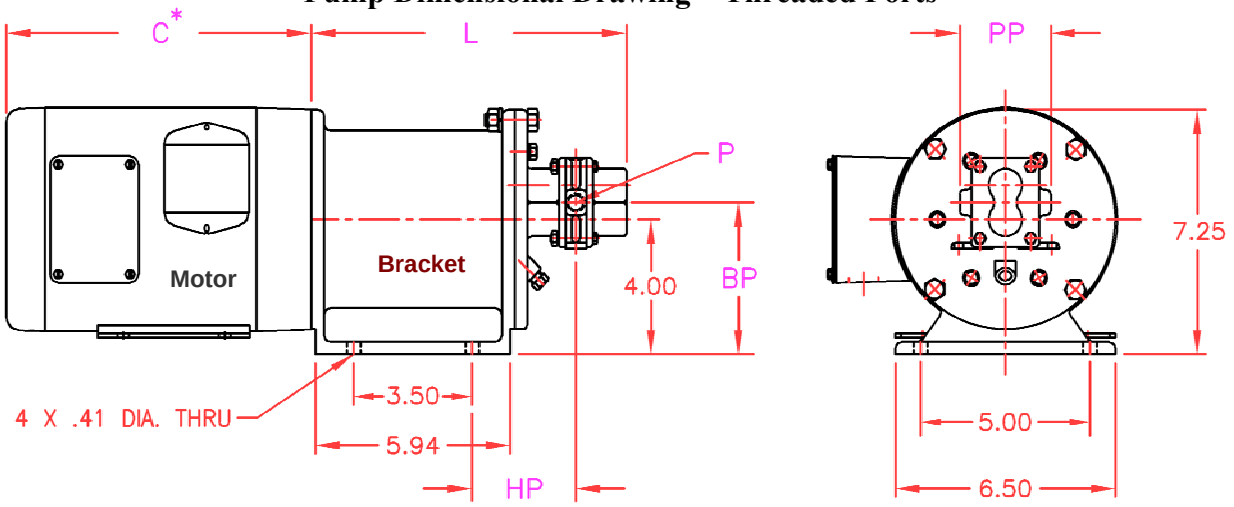
Item #	Description	Qty.	Item #	Description	Qty.
1	Idler Shaft	1	20	Drive Shaft	1
2	Rear Housing	1	21	Center Housing	1
3A	Bearing, Short *	3	22	Drive Gear	1
3B	Bearing, Long *	1	23A	Key, Drive Gear (Not Shown)	1
4	Bolt, Housing (HHCS) **	4	23B	Key, Idler Gear	1
5	O-ring, Housing	2	24	Pin, Housing Alignment	4
6	Idler Gear	1	25	Pin, Bearing Lock	4
7	Wear Plate	4	26	Nut, Front Housing (3/8-16)	4
8	Front Housing	1	27	Bolt, Front Housing (3/8-16 x 1 ¼ HHCS)	4
9	Plug, 1/8 NPT	1	28	Retaining Ring	6
10	Outer Magnet (Assembly)	1	29	Nut, Housing **	4
11	Inner Magnet (Assembly)	1	30	Lockwasher, Housing **	4
12	Containment Can	1	31	Lockwasher, Front Housing (3/8)	4
13	Key, Inner Magnet	1	32	Lockwasher, C. Can (1/4)	6
14	Screw, Hub (8-32 x 5/8 SHCS)	6	33	Hub, Outer Magnet	1
15	Bolt, Motor (3/8-16 x 1 HHCS)	4	34	Lockwasher, Motor (3/8)	4
16	Pedestal (Mounting Bracket)	1	35	Adapter Plate - NEMA 182/184TC Motor (Not Shown)	1
17	Setscrew, Hub (1/4-28 x 3/8 SHSS-CP)	2			
18	Bolt, C. Can (1/4-28 x 5/8 HHCS)	6	36	Bolt, Adapter (1/2-13 x 1 SHCS) (Not Shown)	4
19	O-ring, Containment Can	1			

* Pump Models 37, 39, 311 & H7 each have four bearings of equal size.

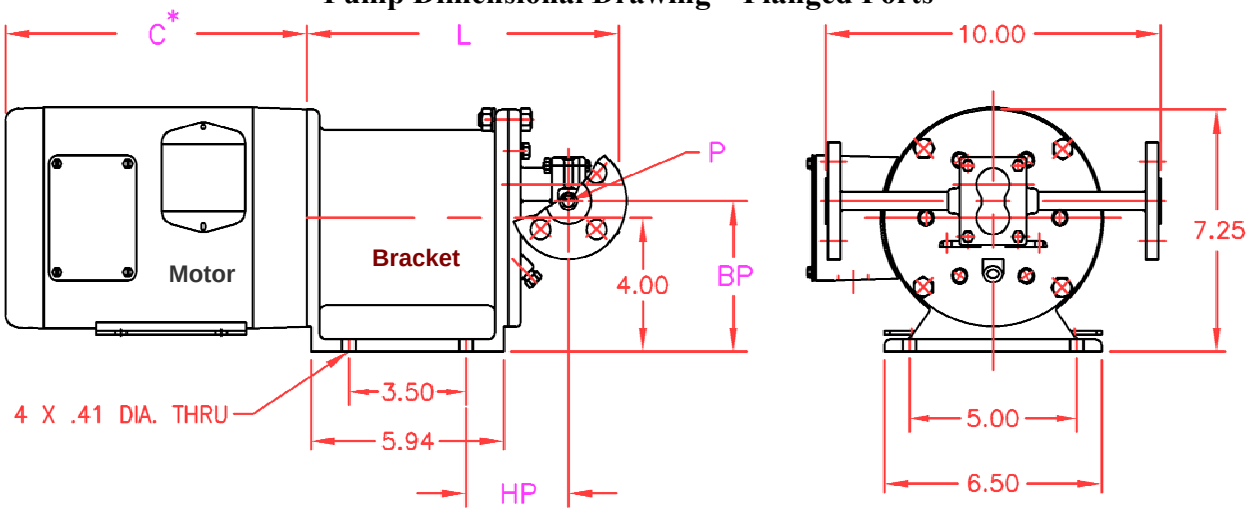
** See Page 31 for bolt size.

Appendix 6: Reference Drawings (Continued)

Pump Dimensional Drawing – Threaded Ports



Pump Dimensional Drawing – Flanged Ports



* See dimensional data from motor manufacturer for "C" Dimension.

Dimensional Data – Mag-Drive Pump

Pump Models		Port Size, Threaded [1] (P)	Port Size, Flanged [2] (P)		Port-to-Port, Threaded (PP)	Length [3] (L)	Base-to-Port CL (BP)	Hole-to-Port CL (HP)
			ANSI	DIN				
3-Series	H-Series	in	in	mm	in	in	in	in
31/33	H3	1/4	1/2	10	2.68	9.31	4.50	3.06
35	H5	1/2	1/2	15	2.44	9.81	4.50	3.31
37R	H7N/H7R	3/4	3/4	20	3.32	10.72	4.75	3.75
37F	H7F	3/4	3/4	20	3.32	10.98	4.75	3.88
39R	—	1	1	25	3.50	11.47	4.75	4.12
39F/311	—	1 ¼	1 ¼	32	4.00	12.22	4.75	4.50

1 Threaded ports are NPT or BSPT.
2 Flanges are ANSI 150# RF or DIN PN16.
3 Length (L) is measured from C-face of bracket to end of pump's rear housing. Add 0.31 inches if pump has Bearing Flush Plugs installed.

Appendix 7: Troubleshooting Guide

Troubleshooting Guide – Part 1

Problem	Possible Cause	Corrective Action
No discharge	Pump not primed	Verify suction pipe is submerged. Increase suction pressure. Open suction valve.
	Wrong direction of rotation	Reverse motor leads or reverse suction and discharge piping.
	Valves closed	Open all suction and discharge valves.
	Bypass valve open	Close bypass valve.
	Air leak in suction line	Tighten connections. Apply sealant to all threads. Verify suction pipe is submerged.
	Clogged strainer	Clean strainer.
	Pump worn or damaged	Rebuild pump.
	Magnetic coupling has decoupled	Stop driver and check temperature and viscosity of fluid. Verify position of outer magnet. Stronger magnetic coupling may be needed.
Insufficient discharge	Suction pressure too low	Increase suction pressure. Verify suction piping is not too long. Fully open any suction valves.
	Bypass valve open	Close bypass valve.
	Partly clogged strainer	Clean strainer.
	Speed too low	Increase driver speed, if possible. Use larger size pump, if required.
	Pump worn or damaged	Rebuild pump.
Loss of suction after satisfactory operation	Pump not properly primed	Reprime pump.
	Air leaks in suction line	Tighten connections. Apply sealant to all threads. Inspect gaskets, if applicable. Verify suction pipe is submerged.
	Air or vapor pockets in suction line	Rearrange piping as necessary.
	Increase in fluid viscosity	Heat fluid to reduce viscosity. Reduce pump speed.
Excessive power consumption	Fluid viscosity higher than specified	Heat fluid to reduce viscosity. Reduce pump speed. Increase driver horsepower.
	Differential pressure greater than specified	Increase pipe diameter. Decrease pipe run.
	Gear clearances insufficient for fluid viscosity	Purchase gears trimmed for the correct viscosity.
	Plastic gear clearance insufficient for fluid temperature	Purchase plastic gear trimmed for the correct temperature.
	Rotating parts binding or severely worn	Disassemble pump and replace worn parts.

Appendix 7: Troubleshooting Guide (Continued)

Troubleshooting Guide – Part 2

Problem	Possible Cause	Corrective Action
Rapid pump wear	Abrasives in fluid	Install suction strainer. Limit solids concentration. Reduce pump speed or use larger pump running at lower speed.
	Corrosion wear	Use materials of construction that are acceptable for fluid being pumped.
	Extended dry running	Install power sensor to stop pump.
	Discharge pressure too high	Increase pipe diameter. Decrease pipe run.
	Housing stress from piping	Align piping with pump ports. Support piping independently of pump.
Excessive noise and vibration	Suction and/or discharge piping not anchored or properly supported	Anchor per Hydraulic Institute Standards.
	Base not rigid enough	Tighten hold-down bolts on pump and motor or adjust stilts. Inspect grout and regrout if necessary.
	Worn pump bearings	Replace bearings.
	Worn motor bearings	Replace bearings or motor.
	Pump cavitation	Increase NPSH available.
Excessive product leakage	Static seal failure caused by chemical incompatibility or thermal breakdown	Use O-rings or gaskets made of material compatible with fluid and temperature of the application.
	Static seal failure caused by improper installation	Install O-rings or gaskets without twisting or bending. Use star-pattern torque sequence on housing bolts during assembly. Allow Teflon O-rings to cold flow and seat during tightening. Torque bolts to specification.
	Pump port connections not properly sealed	Use Teflon tape or other suitable sealant. Use gaskets compatible with fluid and temperature of the application.
	Crevice corrosion of pump housing material	Only pump chemical fluids that are compatible with the pump housing material. Decrease temperature to reduce corrosion rate to acceptable value. Flush idle pumps that are used to pump corrosive chemicals. Eliminate contaminants in the fluid that can accelerate corrosion wear.